NEW SERIES

# SELECTED

# **SWATER**RESOURCES ABSTRACTS



VOLUME 2, NUMBER 7
APRIL 1, 1969

# NEW SERIES

Selected Water Resources Abstracts is published semimonthly for the Water Resources Scientific Information Center (WRSIC) by the Clearinghouse for Federal Scientific and Technical Information (CFSTI) of the Bureau of Standards, U. S. Department of Commerce. It is available to Federal agencies, contractors, or grantees in water resources upon request to: Manager, Water Resources Scientific Information Center, Office of Water Resources Research, U. S. Department of the Interior, Washington, D. C. 20240. Annual subscription is \$22.00 (domestic), \$27.50 (foreign); single copy price is \$3.00.



## SELECTED

## WATER RESOURCES ABSTRACTS

A Semimonthly Publication of the Water Resources Scientific Information Center, Office of Water Resources Research, U.S. Department of the Interior



VOLUME 2, NUMBER 7 APRIL 1, 1969

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As the Nation's principal conservation agency, the Department of the Interior has basic responsibilities for water, fish, wildlife, mineral, land, park, and recreational resources. Indian and Territorial affairs are other major concerns of America's "Department of Natural Resources."

The Department works to assure the wisest choice in managing all our resources so each will make its full contribution to a better United States--now and in the future.

## FOREWORD

**Selected Water Resources Abstracts**, a semimonthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. The contents of these documents cover the water-related aspects of the life, physical, and social sciences as well as related engineering and legal aspects of the characteristics, conservation, control, use, or management of water. Each abstract includes a full bibliographical citation and a set of descriptors or identifers which are listed in the **Water Resources Thesaurus** (November 1966 edition). Each abstract entry is classified into ten fields and sixty groups similar to the water resources research categories established by the Committee on Water Resources Research of the Federal Council for Science and Technology.

Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources. WRSIC is not presently prepared to furnish loan or retention copies of the publications announced.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several planned services of the Water Resources Scientific Information Center (WRSIC). The Center was established by the Secretary of the Interior and has been designated by the Federal Council for Science and Technology to serve the water resources community by improving the communication of water-related research results. The Center is pursuing this objective by coordinating and supplementing the existing scientific and technical information activities associated with active research and investigation program in water resources.

To provide WRSIC with input, selected organizations with active water resources research programs are supported as "centers of competence" responsible for selecting, abstracting, and indexing from the current and earlier pertinent literature in specified subject areas. Centers, and their subject coverage, now in operation are:

- Ground and surface water hydrology at the Water Resources Division of the U.S. Geological Survey, U.S. Department of the Interior.
- Metropolitan water resources management at the Center for Urban Studies of the University of Chicago.
- Eastern United States water law at the College of Law of the University of Florida.
- Policy models of water resources systems at the Department of Water Resources Engineering of Cornell University.
- Water resources economics at the Water Resources Research Institute of Rutgers University.
- Design and construction of hydraulic structures; weather modification; and evaporation control at the Bureau of Reclamation, Denver, Colorado.
- Eutrophication at the Water Resources Center of the University of Wisconsin.
- Water resources of arid lands at the Office of Arid Lands Studies of the University of Arizona.

The input from these Centers, and from the 51 Water Resources Research Institutes administered under the Water Resources Research Act of 1964, as well as input from the grantees and contractors of the Office of Water Resources Research and other Federal water resources agencies with which the Center has agreements becomes the information base from which this journal is, and other information services will be, derived; these services include bibliographies, specialized indexes, literature searches, and state-of-the-art reviews.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
Office of Water Resources Research
U.S. Department of the Interior
Washington, D. C. 20240

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## SELECTED WATER RESOURCES ABSTRACTS

## 01. NATURE OF WATER

## 1B. Aqueous Solutions **AND Suspensions**

THERMOSPHYSICAL PROPERTIES

Monsanto Research Corp. Everett, Mass. Alexander Korosi, and B. M. Fabuss. Office of Saline Water Research and Development Progress Report No. 363, Sept., 1968. 53 p. OSW-14-01-0001-466.

Descriptors: \*Water properties, \*Aqueous solu-tions, \*Saline water, \*Viscosity, \*Thermal conduc-tivity, Physical properties, Viscometers, Elec-trolytes, Sodium sulfate, Magnesium compounds, Potassium compounds.

Identifiers: \*Transport properties, \*Electrolyte mixtures, Othmers rule, Magnesium sulfate, Potas-

sium chloride.

Experimental viscosity measurements were made on water and electrolyte solutions containing one or two of the major sea water components, NaCl, KCl, Na2SO4 and MgSO4, dissolved in water. The viscosity of synthetic calcium-free sea water and its concentrates was also determined. The measurements covered the range from 25 degrees to 150 degrees C. The experimental results on binary solutions were correlated using Othmer's rule, which establishes a linear relationship between the logarithm of viscosity of an aqueous solution and that of water at the same temperature. The correla-tion reproduced the measured data with an overall precision of 0.4 - 0.5%. Literature data were compared with the correlation. The same correlation was used in evaluating the measurements on ternary solutions. Here the additivity of Othmer con-stants was assumed and verified. Thermal conductivity measurements were made on water, NaCl and sea water solutions in the temperature range of 25 -150 degrees C. The molality of NaCl solutions was 0.7 and 3.5, and the solute concentration in the synthetic sea water corresponded to the ionic strength value of normal and three-fold concentrated sea water. A transient rather than a steady state method was used for the measurements. The experimental measurements on these liquids were correlated as functions of temperature and the data were compared with literature information. (Scott-OSW) W69-02784

VAPOR PRESSURE LOWERING OF AQUEOUS SOLUTIONS AT ELEVATED TEMPERATURES, Westinghouse Research Labs., Pittsburgh, Pa. W. T. Lindsay, and C. T. Liu. Office of Saline Water Research and Development Progress Report No. 347, May, 1968. 235 p. OSW-14-01-0001-407.

Descriptors: \*Sodium chloride, \*Vapor pressure, \*Thermodynamics, \*Aqueous, \*Solutions, \*Water structure, Sea water, Heavy water, Sodium sulfate, Entropy, Enthalpy, Free energy, Physicochemical properties, Electrolytes, Ions. Identifiers: \*Boiling point elevation, Lithium compounds, Cesium compounds, Activity, Salt solutions, Excess properties, Osmotic coefficients.

An experimental method was developed for deter-nining osmotic coefficients of aqueous solutions by vapor-pressure lowering measurements at 125 legrees C to 300 degrees C. Measurements were made on sodium chloride solutions to as low as 0.1 nolal. Activity coefficients were obtained for the salt, and excess thermodynamic functions were calculated for both components. The partial excess entropy of the salt was found to have a primary in-luence on the thermodynamics of solutions at high nuence on the thermodynamics of solutions at high temperatures. Results were interpreted in terms of on association and the effects of ions on the struc-cure of water. Measurements were also made on solutions of lithium chloride, cesium chloride, sodi-um sulfate, magnesium sulfate and a mixture simu-ating a sea water concentrate. Association and

hydrolysis reactions were found to be important at high temperatures in solutions of higher-valencetype salts and solutions of mixtures containing these salts. The vapor pressure of heavy water was redetermined to 300 degrees C. An improved estimate was made for the critical pressure of heavy water. The differences between solutions of NaCl in H2O and D2O were investigated. (Scott-OSW) W69-02785

## 02. WATER CYCLE

## 2A. General

URBAN HYDROLOGIC RELATIONSHIPS,

Maine Univ., Orono. W. Viessman, Jr., W. R. Keating, and K. N.

Maine Water Resources Center, Publication No 6, 18 pages, Dec 1968. OWRR Project A-010-Me.

Descriptors: \*Hydrology, \*Unit hydrographs, Routing, Infiltration.

Identifiers: \*Inlet hydrographs, Hydrologic simula-

This research project was conducted to determine: (1) the degree to which a simple linear reservoir model could reconstitute hydrographs of runoff from urbanized inlet areas; (2) the applicability of the inlet hydrograph model combined with a linear channel model and additional attenuation features for computing runoff from a large composite urban drainage area; and (3) the nature of a general loss function for use in urban runoff studies. Objectives (1) and (2) have been satisfied. Objective (3) has been partially met but requires further study which will depend on data not available at the completion of this report. (Author) W69-02408

GROUND-WATER FLOW RELATED STREAMFLOW AND WATER QUALITY, Geological Survey, St. Paul, Minn.

W. A. Van Voast, and R. P. Novitzki. Water Resour Res, Vol 4, No 4, pp 769-775, Aug 1968. 7 p, 4 fig, 11 ref.

Descriptors: \*Groundwater flow, \*Streamflow, \*Water quality, Aquifers, Groundwater, Hydrology, Minnesota, Groundwater recharge, \*Hydrogeology, Surface waters, Topography, Geology, \*Groundwater geology. Identifiers: Yellow Medicine River (Minn.), Geologic profiles.

A ground-water flow system in southwestern Minnesota illustrates water movement between geologic units and between the land surface and subsurface. Flow patterns indicate numerous zones of ground-water recharge and discharge controlled by topography, varying thicknesses of geologic units, variation in permeabilities, and the configuration of the basement rock surface. Variations in streamflow along a reach of the Yellow Medicine River agree with the subsurface flow system. Increases and decreases in runoff per square mile correspond to ground-water discharge and recharge zones. Ground-water quality variations between calcium sulfate waters typical of the Quaternary drift, and sodium chloride waters typical of the Cretaceous rocks are caused by mixing the 2 water types. Mixing zones agree with ground-water flow patterns along the hydrologic section. (USBR) W69-02570

MATHEMATICAL SIMULATION STREAM-AQUIFER SYSTEM, Colorado State Univ., Fort Collins. Robert A. Longenbaugh.
Proc Ser No 3, Symp Amer Water Resour Ass, San
Francisco, Calif, pp 74-83, Nov 1967. 10 p, 7 fig, 8

Descriptors: \*Groundwater geology, Groundwater, Groundwater flow, Groundwater geology, Groundwater, Groundwater flow, Groundwater recharge, Water resources, \*Aquifers, Simulation, Computer programming, Hydrology, Deep wells, Atmospheric precipitation, Streams, Streamflow, Irrigated land, \*Water table, Hydraulic conductivity, Finite differences, Pumping, \*Recharge, Colorado, \*Mathematical models

Identifiers: Arkansas River Valley.

A generalized digital computer program simulates he conjunctive use of surface and ground water in a stream-aquifer system. The model was adapted to the 25-mi reach of the Arkansas River Valley between La Junta and Las Animas, Colo. Water table fluctuations in the aquifer, and water exchange between the river and aquifer were studied with time. Variables considered included: water applied within the area as irrigation; recharge due to precipitation; withdrawals from the aquifer by pumps and phreatophytes; and geologic parameters of permeability, storage coefficient, bedrock elevation, and initial amount of water in storage. A comprehensive hydrologic evaluation by the Geological Survey provided data used in verifying the model. The period from Oct 1, 1963, to Oct 1, 1964, was simulated, and experience with the model indicated that satisfactory verification was obtained. Modeling ground-water systems with digital computers provides flexibility, rapid analyses, and an economical approach. Using digital computer models for making administrative decisions and for optimizing water resources is expected. (USBR) W69-02591

A WATERSHED FLOW STOCHASTIC STRUCTURE, MODEL OF

Pennsylvania State Univ., University Park. Harsha Desai, and David L. Raphael. Proc Ser No 3, Symp Amer Water Resour Ass, San Francisco, Calif, pp 59-73, Nov 1967. 15 p, 5 fig, 4

Descriptors: \*Watersheds (Basins), \*Drainage basins, Hydrology, Runoff forecasting, Runoff coefficient, \*Stochastic processes, Surface runoff, Runoff, Rainfall, Markov processes, Atmospheric precipitation, Routing, Hydrographs, Rainfall-ru-noff relationships, Impoundments, Mathematical

Identifiers: \*Catchments, \*Hydrologic models, \*Stochastic models, Markov chain, Susquehanna

A study was conducted to develop a model for predicting watershed surface flow resulting from precipitation. This was to be achieved with more accuracy and simpler computations than was possible with conventional methods. The hydrologic phenomenon of surface flow due to rainfall was as sumed to approach that of an absorbing Markov chain process with certain absorbing states in the body of the chain. Transfer coefficients were estimated as an average of various proportions for the total time period considered. Total rainfall and total surface flow attributed to this rainfall were estimated. The ratio of the resultant surface flow and rainfall responsible for this flow was the estimated average proportion of surface flow for the basin. Estimated flows were very close to actual flows except for the first 2 days of a 9-day period. those except for the first 2 days of a 9-day period. The model gave the total response behavior of the system although it was not reported ir. detail. The objective of the study, to predict surface flow from an interconnected system of watersheds, was accomplished successfully; however, further refinement and development must be accomplished to make the model a useful hydrologic tool. (USBR) W69-02592

THE OPTIMUM USE OF A GROUND-WATER AND SURFACE-WATER SYSTEM: A PARAMETRIC LINEAR PROGRAMMING AP-

PROACH, California Univ., Berkeley. For primary bibliographic entry see Field 06A. For abstract, see .

## Group 2A - General

W69-02619

#### SYNTHESIZING DAILY DISCHARGE FROM RAINFALL RECORDS,

Geological Survey, Carson City, Nev. For primary bibliographic entry see Field 07C. For abstract, see . W69-02694

TRITIUM MEASUREMENTS IN NATURAL HAWAIIAN WATERS: INSTRUMENTATION, Hawaii Univ., Honolulu. Water Resources

Research Center. For primary bibliographic entry see Field 07B. For abstract, see .

W69-02781

## MATHEMATICAL SIMULATION OF SMALL WATERSHED HYDROLOGIC PHENOMENA,

Utah Water Research Lab., Logan. V. V. Dhruva Narayana, and Jay M. Bagley. Research Project Technical Report to Office of Water Resources Research, Department of Interi-or, December 1967, Washington D. C. 99 p, 26 fig, 37 ref. OWRR Project B-011-Utah.

Descriptors: \*Surface runoff, \*Mathematical simulation, Small watersheds, Hydrograph synthesis, Hydrographs, \*Abstractions, Precipitation, Interception, Infiltration, Depression storage, Routing, Routing procedure, \*Hydrologic process, Simulation, Dynamic system, Schematic diagrams, Watershed shape, Watershed size, Soil characteristics. teristics, Vegetative characteristics, Channel geometry.

In many hydrologic investigations concerning small watersheds, data and observations are totally inadequate to provide a basis for outflow hydrographs. Consequently, a variety of empirical approaches have been developed which have limited rational validity. Hydrograph synthesis offers a reasonable approach to predicting the outflow hydrograph characteristics. In order to synthesize a nydrograph characteristics. In order to synthesize a hytrograph, it is necessary to mathematically describe the physical behavior of the dynamic processes involved in the hydrologic phenomena. Hydrograph synthesis may be considered to comprise (a) hydrographs (actual or simulated) of precipitation, (b) hydrographs of abstractions such as interception, infiltration, and depressional storage, (c) routing or translating the net rainfall rate (rate of rainfall excess) in finite intervals of time and distances up to the outlet point. The complexities of this routing procedure are many, considering the variable factors such as the shape and size of watershed, soil and vegetative characteristics, nonuniform surface conditions, slopes, teristics, nonuniform surface conditions, slopes, and channel geometry. This report is a review of the relationships developed for describing each hydrologic process from the design storm pattern to the final phase of the channel routing. Satisfactory simulation requires connecting all of these process descriptions in such a manner that they combine into a logical and compatible total dynamic system. Schematic diagrams are presented in the discussion and the various methods available for different stages of hydrograph synthesis are indifferent stages of hydrograph synthesis are indicated. W69-02798

APPLICATION OF AN ELECTRONIC ANALOG

APPLICATION OF AN ELECTRONIC ANALOG COMPUTER TO THE PROBLEMS OF RIVER BASIN HYDROLOGY, Utah Water Research Lab., Logan. John Paul Riley, and Duane G. Chadwick. Research Project Technical Report to Office of Water Resources Research, Department of Interior, December 1967, Washington D. C. 199 p, 11 tab, 56 fig, 3 append, 63 ref. OWRR Project B-011-Utah.

Descriptors: \*Hydrologic models, \*Hydrologic simulation, \*Simulation, \*Electronic analog computer, Infiltration, Runoff, Rainfall, Precipitation, \*Watershed studies, \*Snowmelt, Evapotranspira-

tion, \*Hydrology, \*Hydrologic research, \*Water yields, \*Water rousource planning and develop-ment, Experimental watersheds, Soil moisture, Semiarid watershed studies, Convective storms.

As demands upon available water supplies increase, there is an accompanying increase in the need to assess the downstream consequences resulting from changes at specific locations within a hydrologic system. This problem was approached by electronic analog simulation of the hydrologic system. The complexity of a hydrologic model de-pends to a large extent upon the magnitude of the time and spatial increments utilized in the model. The increment size selected depends upon the types of problems to be solved. Three models are described, and in each succeeding model the definition in terms of time and/or space is improved. While the improved model is capable of solving the same heirarchy of hydrologic problems as its predecessor, it is also capable of solving many additional problems which require a higher degree of definition. Preliminary verification studies for both the second and third models have shown close agreement between observed and computed discharge hydrographs from prototype basins. W69-02799

## 2B. Precipitation

INSTRUMENTATION AND OPERATION OF METEOROLOGICAL AND STREAM GAGING STATIONS ON MAYNARD CREEK, Montana State Univ., Bozeman. Joint Water Resources Research Center.
Theodore T. Williams.

Montana University Joint Water Resources Research Center Report No. 7, February 1967. 9 p, 8 fig, 16 tab, 1 append. OWRR Project A-006-Mont.

Descriptors: \*Weather data, \*Watersheds (Basins), Montana, Raingages, Venturi flumes, Thermometers, Hygrometry.

Five meteorological stations for the measurement of precipitation, air temperature and humidity, and of precipitation, air temperature and humidity, and three stream gaging stations were established on Maynard Creek within the Bridger Hydro-Meteorological Research Area northeast of Bozeman, Montana in 1965. Operation of three of the meteorological stations and the stream gaging stations began in August 1965, and was continuing in February 1967. Precipitation measurements were made in Belfort recording weighing raingages; temperature and humidity were measured by were made in Bellort recording weighing raingages; temperature and humidity were measured by Belfort recording hygro-thermographs; stream discharge was measured in Parshall flumes equipped with Leupold and Stevens Type F recorders. Summaries of data collected in 1965 and 1966 were included. (Author) W69-02485

## 2C. Snow, Ice, **AND Frost**

HYDROLOGICAL BUDGET STUDIES ON GEOPHYSICALLY TEMERATE GLACIERS, Massey Univ., Palmerston North (New Zealand). R. D. Thompson. J of Hydrol (New Zealand), Vol 7, No 1, pp 13-23, 1968. 11 p, 3 fig, 2 tab.

Descriptors: \*Hydrologic budget, \*Glaciers, Ablation, Firn, International Hydrological Decade, Methodology.
Identifiers: \*Glacial hydrology, \*New Zealand, \*Orwell Glacier, Maritime-polar environment.

The hydrological budget in a maritime-polar glacial environment is studied to contribute to the clarification of the critical relationship between suban-tarctic glacial hydrology and meteorological parameters. The hydrological budget of the Orwell Glacier at Signy Island in British Antarctic Territory was measured with special reference to the changes in glacier mass associated with water movement onto, within and from the glacier. The influence of meteorological parameters on the gla-cial hydrology, englacial temperature structures, and surface velocity patterns are areas of special research. The meteorological-hydrological rela-tionships on a macro- and microscopic scale involved the evaluation of glacier fluctuations in terms of available and easily measured synoptic parameters. The micro-investigations were con-cerned with the energy-transfer processes and the actual energy change at the glacier surface. (L-laverias-USGS) W69-02691

## 2D. Evaporation and **Transpiration**

**EVAPOTRANSPIRATION--A** REVIEW LITERATURE WITH PARTICULAR ATTENTION TO THE ROLE OF ADVECTED ENERGY AND LYSIMETER STUDY OF EVAPOTRANS-PIRATION,

Nebraska Univ., Lincoln.

N. J. Rosenberg.
Horticulture Progress Report 53, Agricultural Experiment Station, University of Nebraska. 111 pp.
OWRR Project A-001-Neb.

Climatology, \*Advection, on, Estimating Descriptors: \*Evapotranspiration, Estin \*Lysimeters, \*Energy balance. Identifiers: \*Literature review. equations,

The scope of evaporation and drought in the Great Plains is discussed and a historical review of research in evapotranspiration is presented. The theory of aerodynamics, energy budget and empirical approaches to estimation of evapotranspiration is discussed and evaluated. Literature related to the problem of advective energy sources unaccounted for by the radiation balance is reviewed in detail. Lysimetry methods and practices are reviewed to permit the refinement of the use of precision lysimeters in measuring evapotranspiration. A total of 225 references are appended. (Reed-Nebraska) W69-02486

LEVEL **FLUCTUATION EVAPOTRANSPIROMETERS**,

Geological Survey, Phoenix, Ariz.
T. E. A. Van Hylckama.
Water Resour Res, Vol 4, No 4, pp 761-768, Aug 1968. 8 p, 7 fig, 24 ref.

\*Fluctuation, Descriptors: Transpiration, Descriptors: \*Fluctuation, Transpiration, Southwest U. S., Groundwater, Evapotranspiration, Diurnal, \*Water level fluctuations, Bibliographies, Water table, Bubbles, Barometric pressures, Temperature, Plastics, Air, Soil moisture, Agricul-

Identifiers: \*Evapotranspirometers, Buckeye Project (Ariz), Air bubbles.

Eleven plastic-lined evapotranspirometer tanks were constructed near Buckeye, Ariz. Levels of the artificially maintained ground water in these instruments show distinct diurnal fluctuations. On bare tanks or on vegetated tanks that are not transpiring, these fluctuations are highly correlated with diurnal and semidiurnal atmospheric fluctuations. Two nal and semidiurnal atmospheric fluctuations. Two possible reasons for such responses are that: (1) air bubbles may exist in the saturated zone, or (2) the flexibility of the plastic lining. The barometric efficiency is about 40%. On vegetated tanks that are transpiring, the water level and barometric curves are out of phase, but if water levels are corrected for atmospheric pressure fluctuations, a curve appears representing the hourly rate of water use. Results show that plastic-lined evapotranspirometers, of which there are many in the southwestern United States, may be capricious instruments yielding data that should be handled with caution. (USBR) W69-02569

## Streamflow and Runoff — Group 2E

TRANSPIRATION AND THE STOMATA OF LEAVES.

Connecticut Agricultural Experiment Station, New

Haven.
Paul E. Waggoner, and Israel Zelitch.
Sci, Vol 150, No 3702, pp 1413-1420, December 10, 1965. 8 p, 5 fig, 1 tab, 48 ref.

Descriptors: Plant physiology, \*Transpiration, \*Stomata, \*Leaves, Photosynthesis, \*Transpiration control, Water vapor, Water loss, \*Pores, Environmental effects, Turgidity, Inhibitors, Resistance, Temperature, Spraying.

Outlined in this article were the mechanism of stomatal opening and closing and the influence of sto-matal apertures upon the diffusion of gas particularly the water vapor that escapes the moist leaf in-terior. These two areas were studied with respect to turgor and stomatal opening, environment, biochemical inhibitors, history of resistance stu-dies, stomatal resistance and transpiration, leaf temperatures, photosynthesis and spraying to conserve water that would be lost to transpiration. The study of transpiration and the stomata of leaves is important in arid climates since water loss through leaf pores is controlled by pore size, which varies with environment and chemical sprays. (Blecker-Arizona) W69-02746

LEAF TEMPERATURES OF DESERT PLANTS. Missouri Botanical Garden, St. Louis.

David M. Gates, Ronald Alderfer, and Elwynn Taylor.

Sci, Vol 159, No 3818, pp 994-995, March 1, 1948. 2 p, 1 fig, 1 tab.

Descriptors: \*Desert-plants, Semiarid climates, \*Air temperature, \*Energy budget, Radiation, Wind velocity, Humidity, \*Measurement, Tem-Wind velocity, Humidity, \*Measurement, Temperature, \*Leaves, Solar radiation, Water vapor, Transpiration, Computer programs, Diffusion, Re-

Identifiers: \*Leaf temperature, \*Radiometer.

The leaf temperatures of many plants of semiarid regions are very near air temperature. A new pistol-grip infrared radiometer was used to measure the leaf temperature of 7 plant species. The leaf tem-peratures of all plants except Opuntia were within 2 or 3 degrees of air temperature. The blade temperatures of Opuntia were 10 to 16 degrees above air temperature. Theoretical justification for the observation was given based on an energy budget analysis. The energy budget for a plant leaf was programmed for computer analysis for any given programmed for computer analysis for any given value of radiation absorbed, air temperature, wind speed, relative humidity, leaf size and diffusion resistance. The leaf temperature has a direct effect on the transpiration rate of plants in arid climates. (Blecker-Arizona) W69-02749

CHANGES IN EVAPORATION RATES ALONG A 17-KM TRANSECT IN THE SUDAN GEZIRA, Nottingham Univ. (England). School of Agricul-

Utre.
D. C. Davenport, and J. P. Hudson.
Agr Meteorol, Vol 4, No 5, pp 339-352, September
1967. 14 p, 10 fig, 1 tab, 20 ref.

Descriptors: \*Evaporation, Evaporators, \*Transpiration, \*Water vapor, \*Wind velocity, Cotton, Advection, Irrigated land, Vapor pressure, Evaporation pans, Air temperature, Variability, Arid climates, Meteorological data.
Identifiers: Sudan, Upwind, Downwind.

This paper discussed magnitude and extent of lateral variation of evaporative demand in winter in large fields of cotton lying downwind of dry areas, along a 17 km transect in the Sudan Gezira scheme. along a 17 km transect in the sudan Gezha Scheine.
Evaporation rates were measured from open water
in Hudson evaporimeter dishes. At the leading edge
of each cotton field evaporation was greatest at the
upwind boundary and decreased logarithmically
with distance inside the cotton field. Greatest decrease in evaporation in the lateral direction-about 30%--occurred within the first 60 m of a cotton field. On days of high evaporative potential, transpiration from the upwind border area of cotton increased the concentration of water vapor in the air more quickly than on days when evapora-tion was less severe. The rate of evaporation per day appeared to be highly influenced by the daily wind run that was measured at a height of 2 meters above ground at both windward and leeward edges of the field. (Blecker-Arizona) W69-02753

## WATER BALANCE AND EVAPORATION STU-

Poona Observatory (India).

M. Rama Rao.

Nature, Vol 209, No 5012, pp 776, November 20, 1965. 1 p, 1 fig.

Descriptors: \*Water balance, \*Evaporation, \*Winter, \*Soil moisture, Condensation, Air-earth interfaces, Radiation, Wavelengths, Surfaces, \*Temperature, Vapor pressure. Identifiers: India, \*Penman's equation.

During the winter months on clear-sky days systematic measurements were made to find the surface soil moisture over Poona, India. It was found that there was a daily variation of soil moisture, reaching a minimum at the maximum epoch of temperature and a maximum at the minit aim temperature epoch. It appeared from Penir n's equation for evaporation that both during da, nd night there was a process of condensation taking place near the surface of the earth which in the day was completely outbalanced by the incoming shortwave radiation, resulting in a net evaporation. In arid and semi-arid zones this factor is important for the study of water balance in relation to crop development in winter and may explain the large vegetation growth during these months when there is no rainfall. (Blecker-Arizona) W69-02764

## CALCULATED AND OBSERVED EVAPORATION IN A DRY MONSOONAL ENVIRON-MENT,

Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Land Research.

W. R. Stern, and E. A. Fitzpatrick.

J Hydrol, Amsterdam, Vol 3, No 3, pp 297-311, November 1965. 15 p, 4 fig, 3 tab, 21 ref.

Descriptors: \*Evaporation, \*Arid climates. Evaporation pans, Evaporators, Regression analysis, Vapor pressure, Air temperature, Climatology, \*Dry seasons, Monsoons, \*Wet seasons, Data collections, Analysis, Meteorological data, Variability. Identifiers: \*Penman's formula, Formulas, Australia, Evaporimeters.

A study was conducted in Australia to evaluate Penman's evaporation formula and to analyze errors resulting from the use of several types of data. A considerable improvement in the evaporation estimate was achieved by modifying some of the empirical constrants in the formula. The evaluations together with tank evaporation data provided a reference against which other observations and estimates could be matched. The analysis was carried out with specific reference to selected wet and dry periods of the year. Evaporimeters and Dalton type relations showed a slight lag behind Penman evaporation and that the Thornthwaite and Blaney and Criddle estimates were inadequate to describe either the Penman or tank evaporation regime throughout the year in the climatic environment under study. No single relationship could be identified that would satisfy both wet and dry periods of the year in the arid climate. (Blecker-

W69-02765

A PAN-LAKE EVAPORATION RELATIONSHIP, Commonwealth Scientific and Industrial Research Organization, Aspendale (Australia). Div. of Meteorological Physics.

J Hydrol, Amsterdam, Vol 4, No 1, pp 1-11, April 1966. 11 p, 2 fig, 1 tab.

Descriptors: \*Evaporation pans, \*Evaporation, \*Equations, Diurnal, Solar radiation, Wind velocity, Temperature, \*Heat budget, \*Lakes, Monthly, Vapor pressure, Water temperature, Numerical analysis, Regression analysis. Identifiers: \*Water budget, Pan factor, Pan converging.

The pan conversion relationship was investigated and its numerical coefficient evaluated. This was done by making a comparison with the primary determination of evaporation from the water budget, taking only those days which were rated as 'class A' for the latter determination. The pan conversion method, using the equation that was developed, can provide an estimate of daily lake evaporation from nearby class A pan observations. With observations of reasonably high quality, the standard error of monthly total estimated evaporation would be less than 10%. The equation can be used to estimate lake evaporation in arid climates. (Blecker-Arizona) W69-02766

## EFFECT OF ANTITRANSPIRANT TREATMENT ON LEAF TEMPERATURES,

Hebrew Univ., Jerusalem (Israel). Dept. of Botany. For primary bibliographic entry see Field 03F. For abstract, see. W69-02767

## 2E. Streamflow and Runoff

SMALL-STREAM FLOOD INVESTIGATIONS

SMALL-STREAM FLOOD INVESTIGATIONS
IN MINNESOTA (OCT 1958-SEPT 1965),
Geological Survey, St. Paul, Minn.
Lowell C. Guetzkow, and Kurt T. Gunard.
U S Geol Surv open-file rep, 162 p, Jan 1967. 11

Descriptors: \*Data collections, \*Stage-discharge relations, \*Small watersheds, \*Minnesota, Floods, Streamflow, Hydrographs, Stream gages, Gaging stations, Flow characteristics, Peak discharge. Identifiers: \*Crest-gage stations, Flood peak, Flood

The flooding of small streams in Minnesota was investigated to provide data for construction of bridges, culverts, and other drainage structures for highways. The program provides flood data on streams having drainage areas generally less than 50 sq mi, with particular emphasis on those with areas less than 10 sq mi. The basin parameters investigated for their effect on floods are drainage area, length of main stream, slope of main stream, stream density, relief ratio, basin shape, and vegetal cover. Each of 137 gaging stations has a crest-stage gage, and 85 stations have continuously recorded stage gages and recording rain gages. Hydrographs are drawn for significant floods for most of the recording stations. Each station record contains location, drainage area, records available, type of gage, culvert invert elevations, bankfull stage, and annual maximum stage-discharge data. (Knapp-USGS) W69-02494

WATER RESOURCES DATA FOR ARIZONA, 1967 (PART 1: SURFACE WATER RECORDS). Geological Survey, Tucson, Ariz. Water Resources

U S Geol Surv, Water Resources Div, Ann Rep, Part 1, 237 p, 1967. 4 fig.

## Group 2E-Streamflow and Runoff

Descriptors: \*Data collections, \*Surface water, \*Arizona, Discharge (Water), Gaging stations, Stream gages, Streamflow. Identifiers: Periodic observations.

The 1967 surface-water records for Arizona, from gaging stations, partial-record stations, and miscellaneous sites, are compiled. Each record includes location of station, drainage area, records available, type and history of gage and control, average discharge, extremes, remarks, and daily discharge. A map of Arizona shows locations of active gaging stations. (Knapp-USGS) W69-02496

WATER RESOURCES DATA FOR CALIFORNIA, 1967 (PART 1: SURFACE WATER RECORDS).

Geological Survey, Menlo Park, Calif. Water Resources Div.

U S Geol Surv, Water Resources Div, Ann Rep, Part 1, Vol 1, 488 p, 1967. 4 fig.

Descriptors: \*Data collections, \*Surface waters, \*\*California, Streamflow, Discharge (Water), Gaging stations, Stream gages, Streamflow. Identifiers: Periodic observations.

The 1967 surface-water records for the Colorado River Basin, the Southern Great Basin, and Pacific Slope Basins (excluding the Central Valley) of California, from gaging stations, partial-record sta-tions, and miscellaneous sites are compiled. Each record includes locations of station, drainage area, records available, type and history of gage and control, average discharge, extremes, remarks and daily discharge. A map of California shows locations of active gaging stations. (Knapp-USGS) W69-02497

EFFECTS OF CULTURAL CHANGES ON MAKARA EXPERIMENTAL BASIN, Ministry of Works, Wellington (New Zealand).

Water and Soil Div.

For primary bibliographic entry see Field 03B. For abstract, see . W69-02502

FLOOD FREQUENCY AND CHANNEL CROSS-SECTION OF A SMALL NATURAL STREAM, Bureau of Public Roads, Washington, D. C.

W. D. Potter, F. K. Stovicek, and D. C. Woo.
Bull Int Assoc Sci Hydrol, Vol 13, No.3, pp 66-76, Sept 1968. 11 p, 5 fig, 3 tab, 10 ref.

watersheds, \*Hydrograph analysis, \*Stage-discharge relations, Prediction, Flood plains, Ru-noff, Channels. \*Stage-Identifiers: Pilot study, 10-yr flow.

Based on some observed characteristics of the depths and the cross-sectional areas of channels and the use of the stage-discharge relationship, a promising simple method of establishing the runoff for a recurrence interval of about 10 years on the upper frequency curve for an ungaged small stream is presented. This method was tested successfully on a number of sample streams in the eastern part of the United States with drainage areas less than 400 square miles. This method applies only to stable natural streams without any man-made deter-rent to the natural development of the stream channel or flood plain. W69-02505

A NEW METHOD OF FLOW ROUTING,

D. M. Himmelblau, and R. V. Yates.
Water Resources Res, Vol 4, No 6, pp 1193-1199,
Dec 1968. 7 p, 4 fig, 1 tab, 14 ref.

Descriptors: \*Routing, \*Unsteady flow, \*Streamflow forecasting, Kinetics, Hydrographs, Mathematical studies, Methodology.

Identifiers: Population balance, Routing methods.

A mathematical model for flood routing is presented, using a population balance approach to predict the excess flow above the normal channel flow with four coefficients that can be evaluated at a downstream point from pulses of water upstream. Furthermore, the parameters can be directly re-lated to the general characteristics of the stream in terms of hold up, bypassing, and dead space. The model itself comprises two parallel series of wellmixed vessels without interchange of water and can be modified to make the model more complex. Application of the model to data from the Colorado River in Texas indicates that the model satisfactorily represents the excess flow for pulselike stream W69-02510

FLOODS ON LICKING RIVER IN VICINITY OF SALYERSVILLE, KENTUCKY

Geological Survey, Louisville, Ky. Curtis H. Hannum.

U S Geol Surv open-file rep, 17 p, May 1968. 7 fig, 1 plate, 2 photo.

Descriptors: \*Data collections, \*Floods, \*Kentucky, Hydrologic data, Descriptory, Stage-discharge relations, Stream, low, Flood protection,

Flood plains. Identifiers: Licking River, Salyersville (Kentucky), Flood frequency, Flooded areas.

Floods on Licking River near Salyersville, Kentucky, were studied to obtain hydrologic data that can be used to evaluate the extent, depth, and frequency of floods that affect the economy of developments on the flood plains. The data provides a basis for solving existing flood plain problems and for regulating future land use and development to reduce future flood damage by building and zoning regulations, locating waste disposal and water treatment facilities, and developing recreational areas. The areas inundated by 5, 25, and 50-yr floods are shown on a topographic map, scale 1:12,000. Heights of floods are tabulated. Annual floods are shown graphically demonstrating the irregularity of flood heights and the typical magnitudes of floods. For each gaging station in the area, flood discharges and gage, heights are tabulated. Major flood profiles are drawn. The frequency-gage height relationship is shown graphically. (Knapp-USGS)

STREAMFLOW INCREASES FOLLOWING FARM ABANDONMENT ON EASTERN NEW YORK WATERSHED, State Univ. of New York, Syracuse. Coll. of

Forestry. Peter E. Black.

Water Resources Res, Vol 4, No 6, pp 1171-1178, Dec 1968. 8 p, 4 fig, 1 tab, 14 ref.

Descriptors: \*Water yield, \*Runoff, \*Reforesta-tion, \*Land use, Small watershed, Interception, Evapotranspiration, New York, Rural areas, Precipitation (Atmospheric).
Identifiers: \*Streamflow increases, \*Abandoned

Analyses of long-term records of temperature, precipitation, and streamflow for the Wappinger Creek watershed, southeastern New York indicate that streamflow is slowly but steadily increasing as the result of farm abandonment and natural re-forestation. An increase in the length of the shortest one-quarter flow internal is apparent. Potential evapotranspiration remains constant, but percentages of precipitation occurring as runoff, dormant season runoff, and total runoff have all increased in recent years. The lengthening of the shortest one-quarter flow internal, the seasons of flow increase, and the brushy nature of the vegetation suggest has increased snow accumulation, shading, and pro-longed melt are principal causes for the observed increases in annual and dormant season runoff. (Lang-USGS) W69-02520

A NOTE ON THE AVERAGE PROBABILITY OF EXTREME EVENTS,

Geological Survey, Miami, Fla.

Charles A. Appel. Water Resources Research, Vol 4, No 6, pp 1359, December 1968. 1 p, 1 tab, 2 ref.

Descriptors: \*Probability, \*Floods. Identifiers: \*Average probability, \*Extreme events, K-year flood, Plotting-position-probability.

In a recent paper, Benson showed that the limiting value of the average probability of all floods above the K-year flood is equal to 1/2K when the Califor-nia, Weibull, or Hazen formulas are used to determine plotting positions. This article shows that the limiting value of the average probability is 1/2K for any plotting-position-probability formula of the form p = (m+a) / (n+b) where m is the rank with the highest value taken as 1, n is the number of ranked events, and a and b can be selected arbitrarily, except that b cannot be a negative integer. It is shown that the average probability of floods that equal or exceed K-year floods, out of a series of n floods, 1/2K, when n becomes arbitrarily large. (Seneca-Rutgers) W69-02548

SOME RECENT STUDIES ON NUMERICAL FLOOD ROUTING,

North Carolina State Univ., Raleigh.

Michael Amein.

Proc Ser No 3, Symp Amer Water Resour Ass, San Francisco, Calif, pp 274-284, Nov 1967. 11 p, 6 fig, 11 ref.

Descriptors: \*Flood routing, \*Numerical method, Hydrology, Unsteady flow, Computer programming, Computer programs, Differential equations, Finite differences, Flood hydrographs.

Results are presented of an investigation on certain fundamental aspects of numerical flood routing, based on the solution of unsteady flow equations. A brief review of the approximate methods and their solutions is given. This is followed by a discussion of 3 selected complete methods, including factors affecting the stability and accuracy of the solutions Solution of a flood flow problem on the IBM-360 system illustrates the method. Results are presented and some conclusions are derived on the merits and possibilities of the various methods. (USBR) W69-02588

SOME COMMENTS ON REGIONALIZATION

IN HYDROLOGIC STUDIES, Geological Survey, Arlington, Va. For primary bibliographic entry see Field 08C. For abstract, see. W69-02667

WATER RESOURCES OF GRANT AND HOT

SPRING COUNTIES, ARKANSAS,
Geological Survey, Washington, D. C.
H. N. Halberg, C. T. Bryant, and M. S. Hines.
U. S. Geol Surv Water-Supply Pap 1857, 64 p,
1968. 12 fig, 6 plate, 12 tab, 82 ref.

Descriptors: \*Water resources, \*Arkansas, Streamflow, Duration curves, Hydrographs, Hydrologic data, Water wells, Specific capacity, Aquifers, Water quality, Water yield, Water utilization, Nitrates, Acid mine water, Water pollution.

Identifiers: Grant County (Arkansas), Hot Spring County (Arkansas).

The availability and quality of groundwater and the lithology of the principal aquifers are described, and information is given on surface water availability, including magnitude and frequency of floods and low flows, duration of daily flows, and storage requirements for dependable yields of streams. Quality of water in Quachita and Saline Rivers and many tributary streams is described, and existing or potential river and groundwater pollution is cited. The Ouachita, Saline, and Caddo Rivers yield large

## Streamflow and Runoff - Group 2E

quantities of soft, good-quality water. Small streams in southeastern Hot Spring County and in the Ouachita Mountains have relatively high base flow; in Grant County small streams yield little water during dry periods. At times, sewage and mine drainage pollute a part of Ouachita River in the Lake Catherine area. At low flow, Hurricane Creek water is unfit for most uses. Wells in the Sparta Sand, the principal aquifer, yield as much as 850 gpm of soft water in Grant County. The Carrizo Sand and Cane River Formation are potentially important aquifers in Grant County and southeastern Hot Spring County. Wells in the Wilcox Group yield as much as 300 gpm of fresh water in southeastern Hot Spring County and southwestern Grant County; in the rest of Grant County its water is brackish. Alluvium along the principal streams and in consolidated rocks of the Ouachita Mountains yield small quantities of water variable in quality from place to place. Some of the alluvial water has high nitrate content and may be a health hazard. (Lang-USGS) W69-02677

## A RECONNAISSANCE OF THE WATER RESOURCES OF PICKENS COUNTY, SOUTH CAROLINA.

Geological Survey, Columbia, S. C. F. A. Johnson, George E. Siple, and T. Ray Cummings.

S C Water Resources Planning and Coordinating Comm Rep No 1, 69 p, 1968. 17 fig, 1 plate, 15 tab,

Descriptors: \*Water resources, \*Surface waters, \*Groundwater, \*South Carolina, Water yield, Water quality, Hydrogeology, Base flow, Water wells

Identifiers: Pickens County (South Carolina).

The magnitude and frequency of low flows in Pickens County, S C, have been estimated from gaging station records and from a reconnaissance investigation conducted during 1967. Average flows and 7-day low flows have recurrence intervals of 2 and 10 years have been computed for 26 stream locations. The 2-year (median), 7-day low flows range from about 0.3 cfs per square mi in the southern part of the county to about 0.9 cfs per square mi in the mountainous north. Storage requirements based on low-flow recurrence intervals of 5 and 10 years have been computed also. At most locations surface water in Pickens County has a low dissolved-solids content and is generally suitable for most uses. Wells less than 250 ft deep yield from 1/2 gpm to 500 gpm and an average yield of 21 gpm. Wells in saprolite have the highest yields. Baseflow discharges are 0.3-0.7 million gal per square mi, the maximum potentially available for groundwater withdrawal. Groundwater is of good to excellent quality for most uses. The water is soft, slightly acidic, and low in dissolved solids. (Knapp-USGS)
W69-02679

## MEASURING AND SAMPLING RUNOFF FROM

FLAT LANDS, Agricultural Research Service, Washington, D. C.; and Louisiana State Univ., Baton Rouge. Agricultural Experiment Station.

For primary bibliographic entry see Field 08B. For abstract, see .

W69-02682

## EVALUATION OF CHANNEL CHANGES IN ST. CLAIR AND DETROIT RIVERS,

Weather Bureau, Chicago, Ill. Ivan W. Brunk.

Water Resources Res, Vol 4, No 6, pp 1335-1346, December 1968. 12 p, 6 fig, 3 tab, 9 ref.

Descriptors: \*River flow, \*Channel improvement, \*Great Lakes, Lake Erie, Lake Michigan, Lake Huron, Stage-discharge relations, Stream gages,

Identifiers: St. Clair River, Detroit River, Streamflow estimates.

Extensive improvements for navigation have been made in the St. Clair-Detroit River (SCDR). Channel changes have lowered the level of Lake Michigan-Huron by about 2 feet, bringing about the lowest levels of record in 1964 and 1965. The unrecognized changes in the regimen of the SCDR before 1900 have also resulted in the computation of flows that are much too large. The discharge of Lake Erie and the precipitation in the Erie basin are used to derive more reasonable estimates of the flow of the SCDR before 1900. The amount of material excavated from channels and the annual differences in reported and computed flow of the SCDR from 1869-1908 are tabulated. Hydrographs show computed flow and Lake Erie flow from W69-02693

#### ESTIMATING FLOOD PEAKS FROM SMALL SOUTH AFRICAN CATCHMENTS,

Colorado State Univ., Fort Collins.

B. M. Reich.

J Hydrol, Amsterdam, Vol 3, No 3, pp 231-253, November 1965. 23 p, 10 fig, 3 tab.

Descriptors: \*Flood forecasting, \*Storm runoff, Surface runoff, \*Rainfall, \*Rational formula, Rainfall intensity, Rainfall-runoff relationships, Cover crops, Watersheds (Basins), Peak discharge, Maximum probable flood, Hydrograph analysis, Infiltration, Runoff coefficient, Depth-area-duration analysis.

Identifiers: Cover factor, South Africa.

An attempt was made to replace the 'rational' formula with another rapid and simple means of predicting flood peaks for ungauged watersheds in South Africa that ranged in size from one-fifth to five square miles. Estimates of flood runoff were based on the causative factor, rainfall. The rainfall extremes needed by the method were given. A method was presented by which the 30-minute rainfall extreme can be employed to predict flood peaks very rapidly. Development of the method from the theoretical and empirical concepts was outlined. Results obtained with the method check satisfactorily against eighty-three observed floods recorded in the United States. The method outlined in the study could be used to estimate flood peaks from small catchments in arid climates. (Blecker-Arizona) W69-02751

## RADIOACTIVE TRACING OF STORM RUNOFF ON A SMALL CATCHMENT I EXPERIMENTAL TECHNIQUE, New South Wales Univ., Kensington (Australia).

School of Civil Engineering.

D. H. Pilgrim.
J Hydrol, Amsterdam, Vol 4, No 4, pp 289-305, 1966. 17 p, 2 fig.

\*Storm runoff, Descriptors: \*Radioisotopes, \*Tracking techniques, Watersheds (Basins), \*Instrumentation, Flood forecasting, Onsite tests, Rainfall-runoff relationships, Adsorption, Safety factors, Flow measurement, Sampling, Analytical techniques, Logging (Recording), Calibrations. Identifiers: Time of concentration.

Time of travel of flood runoff from a 96 acre catchment was directly measured by means of radioactive tracers. The objective of the tracing was to investigate the time of concentration and its variations. The tracer was injected at the most remote point on the catchment and time of travel to the outlet was measured under various conditions. Requirements and types of tracers were discussed, together with safety aspects of the project and performance of the tracers. Several of the major problems encountered in the project were major problems encountered in the project were associated with the fact that heavy rainfall and runoff could only be predicted a short time in advance and with low accuracy. Solution of these problems were given. Chromium-51-EDTA had satisfactorily fulfilled requirements of a tracer since adsorption losses were fairly small under conditions of very high dilution and high surface contact. Radioisotopes could probably be used to trace storm runoff from arid areas. (Blecker-Arizona) W69-02769

## RADIOACTIVE TRACING OF STORM RUNOFF ON A SMALL CATCHMENT II DISCUSSION OF RESULTS, New South Wales Univ., Kensington (Australia).

School of Civil Engineering.

D. H. Pilgrim.
J Hydrol, Amsterdam, Vol 4, No 4, pp 306-326, 1966. 21 p, 8 fig, 1 tab.

Descriptors: \*Storm runoff, \*Tracers, \*Tracking techniques, \*Radioisotopes, \*Unit hydrographs, Discharge (Water), Adsorption, Pear discharge, Rainfall intensity, Rainfall-runoff relationships, Watersheds (Basins), Depth-area-duration analysis, Raindrops, Time lag, Precipitation excess, Hydrographs, Runoff.

Identifiers: Time of concentration.

The results of tracing the storm runoff on a 96 acre natural catchment by means of radioactive tracers were discussed. The record of radioactivity with time at the catchment outlet gave a graph of concentration with time of the labeled molecules in the runoff. The record of activity provided a hydro-graph of outflow of the labeled drop of water. Consideration of the form of those records enabled clarification of the concept of time of concentration. Application of time travel measurements to a number of hydrograph synthesis methods was discussed. The results provided information on several aspects of the storm runoff process, including the validity of linear analysis, and apparent partial area runoff production effect and the distribution of initial loss. Tracing of storm runoff from arid lands could possibly be done by use of radioactive tracers. (Blecker-Arizona) W69-02770

## RUNOFF HYDROGRAPHS FROM SMALL TEXAS BLACKLANDS WATERSHEDS, Agricultural Research Service, Washington, D. C.;

and Texas Agricultural Experiment Station, College Station

James R. Williams.

Agricultural Research Service ARS 41-143, pp 1-24, Oct 1968. 24 p, 11 fig, 1 map, 3 tab, 3 ref.

Descriptors: Hydrographs, \*Hydrograph analysis, Runoff, \*Rainfall-runoff relationships, Watersheds (Basins), Precipitation intensity, watersheds, \*Texas.

Runoff hydrographs for ungaged watersheds, ranging in size from 0.275 to 17.6 square miles, in the Blacklands of Texas can be estimated with considerable accuracy by employing certain empirical relationships. These relationships, based on a study of gaged watersheds in the Blacklands, provide estimates of: (1) The peak rate of runoff, (2) the time to peak, and (3) the ordinates of the hydrographs. These relationships require an independent estimate of the volume of runoff; the rainfall intensity for a time period equal to the recession constant; and measurements of certain dimensions of the watershed including area, length of the main stem, slope of the main stem and the elongation ratio. **W**69-02794

## MATHEMATICAL SIMULATION OF SMALL WATERSHED HYDROLOGIC PHENOMENA, Utah Water Research Lab., Logan.

For primary bibliographic entry see Field 02A. For abstract, see . W69-02798

APPLICATION OF AN ELECTRONIC ANALOG COMPUTER TO THE PROBLEMS OF RIVER BASIN HYDROLOGY, Utah Water Research Lab., Logan.

## Field 02—WATER CYCLE

## Group 2E—Streamflow and Runoff

For primary bibliographic entry see Field 02A. For abstract, see. W69-02799

## 2F. Groundwater

PROCEEDINGS SYMPOSIUM ON HYDROLO-GY OF THE COASTAL WATERS OF NORTH

North Carolina Univ., Chapel Hill. For primary bibliographic entry see Field 02L. For abstract, see . W69-02487

UNSTEADY DRAWDOWN IN AN UNCON-FINED AQUIFER,

Wisconsin Univ., Madison. Dept. of Civil Engineer-

D. T. Higgins. pp, 22 fig, 10 tab, 4 append. owrr project A-005-Wis.

Descriptors: Aquifers, Drawdown, Mathematical models, Saturated flow, Unsteady flow.

A theory is needed which accounts for vertical velocity effects in the unsteady drawdown of a two-dimensional, unconfined aquifer adjacent to a stream or reservoir. Present theories inadequately describe water table motion near the outflow face soon after the stream has been drawn down. In this investigation classical potential theory was used to include vertical velocity effects in the drawdown equation. Linear integral solutions were obtained which predict the water table's position as a function of time for both instantaneous and time-dependent. dent stream drawdown. These equations have been solved numerically. For large values of a dimensionless time factor it is shown that these solutions are identical to those of Stallman and Hantush for the corresponding drawdown of confined aquifers. Closed form approximations to these solutions were also obtained for small values of the time factor. Experiments were performed in a sand filled seepage flume to verify the new theory. It was found that the inclusion of vertical velocity effects extends the range of water table drawdown prediction beyond that available with the linearized shallow aquifer solution of Stallman. (Author)

WATER-LEVEL CHANGES IN GRANT AND STANTON COUNTIES, KANSAS, 1939-1968, Kansas State Board of Agriculture. Div. of Water

John D. Winslow, Harold E. McGovern, and Harris

L. Mackey. Kans Univ State Geol Surv, Spec Distribution Publication 37, 17 p, 1968. 5 fig, 2 tab, 6 ref.

Descriptors: \*Water level fluctuations, \*Kansas, Irrigation, Recharge, Evapotranspiration, Hydrographs. Identifiers: Grant County (Kansas), Stanton Coun-

ty (Kansas), Pumpage.

Water level data collected since 1939 in Grant and Stanton Counties, Kansas, are analyzed. Because withdrawals for irrigation have consistently and increasingly exceeded recharge, groundwater levels trend downward with time. The number of irrigation wells increased from 15 in 1940 to 850 in December 1967, when 263,000 ac were irrigated. The drought of 1953-1956 greatly increased both withdrawal for irrigation and water-level decline. Locations of wells, water level declines and irrigation and water-level declines. Locations of wells, water level declines, and irrigated areas are mapped. Hydrographs of selected wells are included. (Knapp-USGS)

DIFFUSION AND DISPERSION IN POROUS MEDIA-SALT WATER MOUNDS IN COASTAL

AQUIFERS,
North Carolina State Univ., Raleigh.
Abdel-Aziz I. Kashef.
N C Water Resources Res Cent Rep No 11, 258 p,
Sept 1968. 39 fig. 12 tab, 85 ref, 8 append. OWRR
Project A-007-NC.

Descriptors: \*Saline water intrusion, \*Diffusion, \*Aquifers, \*Saline water-freshwater interfaces, Pumping, Recharge, Confined water, Dupuit-Forchheimer theory, Unsteady flow, Model studies, Hydraulic models.

Identifiers: \*Coastal aquifers, Leaky confining heds.

A mathematical model of the movement of fresh and salt waters in coastal aquifers in which fresh water is withdrawn by wells is presented. The location of the fresh-salt water interface in artesian and unconfined aquifers is determined on the basis of analysis of hydraulic forces in the body of fresh water. The 3-dimensional flow systems are developed by analogy to 2-dimensional finite-length systems. Dupuit-Forchheimer assumptions are entirely eliminated. Results compare favorably with the best previous techniques but the method is simpler. A FORTRAN program for the IBM 360 was used to obtain dimensionless solutions for 130 cases and the results are summarized in tabular and graphic forms. In field cases many results can be attained easily on a desk calculator. A Hele-Shaw model was constructed to study 2 dimensional flow of 2 immiscible fluids of different viscosities in transient and steady flow. Salt water intrusion was studied combining the effects of natural flow and multiple well pumpage. (Knapp-USGS)
W69-02495

ON THE IMPULSE RESPONSE OF AN AQUIFER, City Univ., London (England). Dept. of Civil En-

gineering. C. Venetis

Bull Int Assoc Sci Hydrol, Vol 13, No 3, pp 136-139, Sept 1968. 4 p, 2 fig, 1 tab, 9 ref.

Descriptors: \*Mathematical studies, \*Dupuit-Forchheimer theory, \*Aquifer, \*Unsteady flow, Groundwater movement, Laplaces equation, Porous media.

Identifiers: Impulse response, One-directional semi-infinite aquifer, Boundary conditions.

The impulse response and the response to a unit step function of the one-directional semi-infinite aquifer is given, derived from the approximate partial differential equation of groundwater flow. An example is presented. W69-02500

A STUDY OF SALT WATER ENCROACHMENT IN THE COASTAL AQUIFER AT DIGHA, MID-NAPORE DISTRICT, WEST BENGAL, INDIA, Geological Survey, Calcutta (India). A. B. Goswami.

Bull Int Assoc Sci Hydrol, Vol 13, No 3, pp 77-87, Sept 1968. 11 p, 6 fig, 2 tab, 6 ref.

Descriptors: \*Saline water intrusion, \*Saline waterfreshwater interfaces, \*Aquifers, \*Coasts, Pumping, Recharge, Tides, Recharge, Wells, Recharge, ing, Recharge Hydrodynamics.

Identifiers: India, Digha, Bay of Bengal, Phreatic

Between 1963 and 1965, sinking of auger boreholes and testing of quality of groundwater at boreholes and testing of quality of groundwater at different depths along the Digha coast of India provided the principal basis for defining the distribution and movement of the saline and fresh groundwater within a phreatic aquifer (7-9 metres in thickness) consisting of fine to coarse grained sand with occasional soft clay lenses of Recent age. The auger holes were sunk along 10 lines in an area of about 25 sa km extending from 3 km east of Digha and the saline and agest of Digha and the saline and the salin about 25 sq km extending from 3 km east of Digha on the east to the confluence of the Subarnarekha on the east to the confluence of the Subarnarekha river with the Bay of Bengal on the west. The results of the study revealed the existence of a fresh water wedge (chloride content varying from 20 to 300 ppm) separated by two saline water zones, one near the top and the other at the bottom of the aquifer. The isochlor of 500 ppm and 2.3 chloride-bicarbonate ratio delineated the saline groundwater body. The 300 and 500 ppm isochlors defined the zone of diffusion which had a variable shape and thickness depending on several factors. Minor movements of the interface occur due to tidal and groundwater recharge variations. The interface was found to occur at much shallower depth than that calculated on the basis of the Ghyben-Herzberg principle. W69-02504

AXISYMMETRIC SEEPAGE THROUGH HOMOGENEOUS AND NONHOMOGENEOUS

POROUS MEDIUMS, Roland W. Jeppson. Water Resources Res, Vol 4, No 6, pp 1277-1288, Dec 1968. 12 p, 5 fig, 21 ref.

Descriptors: \*Infiltration, \*Porous media, \*Soil water movement, \*Mathematical models, Digital computers, Stokes law, Approximation method, Pit recharge, Homogeneity, Heterogeneity. Identifiers: Axisymmetric scepage, Finite dif-

ference methods.

Solutions to steady-state free surface seepage from axisymmetric ponds through homogeneous and nonhomogeneous porous media to a drained layer at a finite depth are obtained by finite difference methods. In the formulation of the boundary value problems, the magnitudes of the radial and axial coordinates are considered dependent variables in the plane defined by the potential function and Stokes' stream function. Example solutions are given for seepage through (1) a homogeneous porous medium; (2) a nonhomogeneous porous medium in which the permeability decreases with depth; and (3) a nonhomogeneous porous medium in which the permeability increases with depth. The methods and techniques employed are equally applicable to other three-dimensional seepage and potential fluid flow problems with axial symmetry and free surfaces. The essential differences in the formulation and solution to other problems will be the boundary conditions. W69-02511

STEADY INFILTRATION FROM A SHALLOW CIRCULAR POND, Commonwealth Scientific and Industrial Research

Organization, Canberra (Australia). Div. of Plant

For primary bibliographic entry see Field 02G. For abstract, see . W69-02512

WATER-LEVEL TRENDS IN SOUTHEASTERN

LOUISIANA, Geological Survey, Baton Rouge, La. Water Resources Div. D. C. Dial.

La Dep of Conserv et al, Water Resources Pam No 22, 11 p, May 1968. 2 fig, 1 pl, 4 ref.

Descriptors: \*Water level fluctuations, \*Groundwater movement, \*Aquifer characteristics, \*Water utilization, Louisiana, Deep wells, Pressure head, Hydrographs, Geohydrologic units, Water table. Identifiers: \*Water level trends, Declining head, Groundwater wastage, Flowing wells.

Current water-level trends are described for aquifers in a 5-parish area lying between Lake Pontchartrain and the Mississippi line, and conditions that have brought about the trends are discussed. Areas of moderate to heavy groundwater withdrawals are shown on a map and water-level trends are graphed for 10 widely-spaced observation wells for the period 1960-1966. Relatively large declines have occurred in deep artesian aquifers, but little or no declines are evident in shallow aquifers. In the deep aquifers, declines range from 5 ft per yr in Western Livingston Parish to 1 ft per yr in areas more remote from heavy withdrawals. Moderate withdrawals, such as at Slidell and Hammond, have caused water-level declines of about 2 ft per yr. A large part of the area's usable groundwater flows to waste from

unused wells, thus contributing to the declining trends. (Lang-USGS) W69-02513

## NEW THEORY OF RECHARGE TO THE ARTE-SIAN BASIN OF THE DAKOTAS,

Geological Survey, Denver, Colo.

Frank A. Swenson.

Geol Soc of Amer Bull, Vol 79, pp 163-182, Feb 1968. 20 p, 5 fig, 2 tab, 33 ref.

Descriptors: \*Groundwater movement, \*Groundwater basins, \*Aquifers, \*Groundwater recharge, Sandstones, Limestones, South Dakota, Leakage, Karst, Hydrogeology, Water quality, Artesian wells, Confined water, Pressure.

Identifiers: \*Dakota Sandstone, Pahasapa Limestone, Englewood Formation.

A new theory of recharge of the Dakota Sandstone in the Dakota Artesian Basin is proposed on the basis of review of older published work and field checking of anomalies discovered in previous explanations. Previously it was believed that the Dakota Sandstone is recharged where it is exposed on the flanks of the Black Hills, and water moves eastward in the sandstone. This is unlikely because no continuous sandstone beds extend from the Black Hills to discharge areas. Head gradient relations and chemical data are also anomalous with regard to this theory. It is proposed that recharge enters the lower Mississippi Pahasapa Limestone and the Englewood Formation on the flanks of the Black Hills. The limestones are very cavernous; streams flowing out of the Black Hills lose most of their water to them. Water moves freely through the cavernous limestone for 100 miles east of recharge until it reaches a zone of Pre-Dakota beveling where the limestones are closer to the Dakota Sandstone and water can move upward to recharge the Dakota Aquifer. Much of the water pumped from the Dakota has moved only a short distance through it. Chemical character and head relations of water in the Dakota support this interpretation. (Knapp-USGS) W69-02515

#### LABORATORY EVALUATION OF SELECTED RADIOISOTOPES AS GROUND WATER TRACERS,

Texas A and M Univ., College Station. For primary bibliographic entry see Field 07C. For abstract, see . W69-02571

MATHEMATICAL SIMULATION OF STREAM-AQUIFER SYSTEM, Colorado State Univ., Fort Collins. For primary bibliographic entry see Field 02A. For abstract, see . W69-02591

## INTRINSIC PERMEABILITY OF HYDROLOGI-CAL POROUS MEDIUMS: VARIATION WITH

TEMPERATURE,
Louisiana State Univ., Baton Rouge.
David B. Greenberg, Ronald S. Cresap, and Terry

A. Malone. Water Resources Res, Vol 4, No 4, pp 791-800, Aug 1968. 10 p, 8 fig, 2 tab, 9 ref.

Descriptors: \*Permeability, \*Porous media, Groundwater, Momentum equation, Darcy's law, Reynolds number, Turbulent flow, Laminar flow. Identifiers: \*Fluid dynamics, Pore size, Quartz

With attention confined to the laminar and turbulent flow regimes experimental work is reported on lent flow regimes experimental work is reported on intrinsic permeability of hydrological porous mediums as a function of temperature variations. Experimental results show that permeabilities of such mediums are thermally sensitive. For cemented quartz mediums permeabilities varied as much as 0.5% per degree C over a 20-60 deg C temperature range. Despite the temperature effect observed, a satisfactory friction factor correlation was obtained for all data utilizing the two-term momentum equation. Measurements with vitrified mediums showed no appreciable temperature coefficient of permeability. As a by-product of the investigation a characteristic length parameter, in terms of the laminar (permeability) and inertial flow coefficients, was used to define a modified Reynolds number for all porous mediums. This length parameter appears to be directly proportional to the mean pore dimension as determined from porosimetry measurements. Data obtained from all samples correlated well in graphical form and are presented in a generalized friction factor (modified Reynolds number) plot. (Llaverias-USGS) W69-02664

## COMPOSITION OF DEEPER SUBSURFACE WATERS ALONG THE ATLANTIC CONTINEN-

Geological Survey, Washington, D. C. F. T. Manheim, and M. K. Horn. Southeastern Geology, Vol 9, No 4, pp 215-236, Nov 1968. 22 p, 5 fig, 2 tab, 68 ref.

Descriptors: \*Groundwater, \*Water quality, \*Hydrogeology, \*Atlantic Coastal Plain, Florida, Georgia, Maryland, North Carolina, South Carolina, Osmosis, Membrane processes, Clays, Filtration, Salinity, Sedimentation, Lagoons. Identifiers: \*Continental margin, Paralic sediments, Barrier islands.

The composition and distribution of deeper groundwaters beneath the Coastal Plain and continental margin of the eastern US were studied by electrical well log evaluation, use of existing water analyses, literature search, and oil-well pore fluid analyses. Meteroic water greatly influences water quality down to 1000 m. In the Georgia-South Carolina area potable water may occur below saltier layers deeper than 1000 m, and more than 120 km offshore. Deeper waters have irregularly arranged brackish and saline zones with a trend of salinity increase with depth. Salinites of over 100,000 ppm are found in pre-Upper Cretaceous rocks in the Salisbury Embayment of Maryland and Delaware, Hatteras embayment, south Georgia and all of Florida. Brines are associated with red-beds and evaporites. Salt filtration by clay membranes does not seem to occur in Coastal Plain sediments, but clay membranes do seem to promote osmotic flushing of salty strata by fresher waters. (Knapp-W69-02666

## FIELD OBSERVATIONS ON CHANGES IN THE SUBSURFACE WATER REGIME DURING INFLUENT SEEPAGE IN THE SANTA CRUZ RIVER.

Arizona Univ., Tucson. Water Resources Center. L. G. Wilson, and K. J. De Cook. Water Resources Res, Vol 4, No 6, pp 1219-1234, December 1968. 16 p, 6 fig, 24 ref.

Descriptors: \*Infiltration, \*Alluvium, \*Groundwater movement, Surface-groundwater relationships, Pit recharge, Arizona, Piezometers, Observa-tion wells, Unsaturated flow, Water levels, Water level fluctuations.

Identifiers: Tucson (Arizona), Santa Cruz River, Groundwater mounds.

Field studies were conducted during the winter 1965-1966 at an instrumented research site near Tucson, Arizona, to characterize changes in the subsurface water regime of the stratified sediments at the site during influent seepage in the Santa Cruz River. At the peak of recharge from the principal runoff event of the winter, observation well data accounted for 33% of the observed total change in the subsurface water content. The remaining 67%. observed by means of moisture logs in access tubes, was contained in two near-saturated mounds in the intermediate vadose zone. Slow drainage of water from these mounds into the semiconfined phreatic zone apparently reduced the rates of recession of observation well hydrographs. Water content changes in the intermediate vadose zone and related long-term drainage should be accounted for during water balance studies and aquifer testing in the Tucson Basin

#### WATER RESOURCES OF GRANT AND HOT SPRING COUNTIES, ARKANSAS, Geological Survey, Washington, D. C

For primary bibliographic entry see Field 02E. For abstract, see . W69-02677

#### ELECTRICAL-ANALOG ANALYSIS OF HYDROLOGIC DATA FOR SAN SIMON BASIN COCHISE AND GRAHAM COUNTIES, ARIZONA.

Geological Survey, Washington, D. C. Natalie D. White, and William G. Hardt.
U S Geol Surv Water-Supply Pap 1809-R, 30 p, 1965. 5 fig, 2 plate, 1 tab, 19 ref.

Descriptors: \*Analog models, \*Forecasting, \*Water level fluctuations, \*Flow nets, Aquifer characteristics, Water yield, Groundwater, Transmissivity, Storage coefficient, Arizona, Hydrologic data, Water supply, Aquifers.
Identifiers: San Simon basin (Arizona), Cochise

County (Arizona), Graham County (Arizona).

Effects of projected ground-water withdrawals from the alluvial-fill aquifer in San Simon basin, Arizona, were determined by an analysis of an electric-analog model of the aquifer. The aquifer system is divided into four units; an upper watertable aquifer, confining layer of blue clay, lower artesian aquifer, and a marginal zone where the two aquifers form one hydrologic unit. Characteristics of the lower aquifer and the confining bed, which were needed to construct the model, were determined by analyzing flow nets, well data, and historical water levels. The analog model provides a thorough analysis of an entire hydrologic system under complex conditions imposed by increased developments. The model was verified and adjusted against a map of net change in water levels from 1915 to 1960. On the basis of an hypothesized amount and distribution of pumpage, analysis of the model indicated water-level declines from 1960 to 1980 of about 120 ft in the Bowie area and about 160 ft in the San Simon area. The water levels in 1980 were predicted by superimposing the decline data on known 1960 data. Correspondence of projected water-level conditions to future field conditions will depend on the conformance of future pumpage to the hypothesized pumpage. (Stein-hilber-USGS) W69-02678

## A RECONNAISSANCE OF THE WATER RESOURCES OF PICKENS COUNTY, SOUTH CAROLINA.

Geological Survey, Columbia, S. C. For primary bibliographic entry see Field 02E. For abstract, see . W69-02679

## CONTRIBUTIONS TO THE HYDROLOGY OF ASIA AND OCEANIA--GROUND-WATER HYDROLOGY OF THE PUNJAB, WEST PAKISTAN, WITH EMPHASIS ON PROBLEMS CAUSED BY CANAL IRRIGATIONS,

Geological Survey, Washington, D. C. D. W. Greenman, W. V. Swarzenski, and G. D. Bennett.

U S Geol Surv Water-Supply Pap 1608-H, 66 p, 1967. 12 fig, 10 plates, 4 tab, 21 ref.

Descriptors: \*Groundwater, \*Water quality, \*Ground-water recharge, \*Water table, \*Surfacegroundwater relationships, Reclamation, Irrigation practices, Ground-water movement, Hydrogeology, Leaching, Seepage, Water yield, Water wells, Water level fluctuation, Hydrologic data, Aquifers, Water management (Applied).

## Field 02—WATER CYCLE

## Group 2F-Groundwater

Identifiers: Water logging, Water quality changes, Hydrologic changes, Punjab (West Pakistan), West Pakistan, Tubewells.

Rising water tables and salinization of land as a result of canal irrigation threaten the agricultural economy of the Punjab, West Pakistan. This report summarizes the findings of an investigation started in 1954 to determine the relations between irrigation activities, natural hydrologic factors, and the incidence of waterlogging and subsurface-drainage problems. Hydrologic findings are: most of the Punjab is underlain to depths of 1,000 ft or more by unconsolidated alluvium, which is saturated to within a few feet of land surface; large capacity wells, yielding 4 cfs or more, can be developed almost everywhere; ground water within a depth of 500 ft averages less than 1,000 ppm of dissolved solids in about two-thirds of the Punjab; total dissolved solids range from 1,000 to 20,000 ppm in the remainder of the area; leakage from canal systems is principal cause of rising water levels and constitutes the major components of ground-water recharge; original relationship between ground and surface waters have been modified. The report concludes that the ground water reservoir, containing about 2 billion acre-feet of usable water, is of great economic and management value. The West Pakistan Water and Power Development Authority's long range plan for reclamation involves the construction of a network of high capacity wells, which will help supply irrigation requirements and provide subsurface drainage. Some quality-of-water changes may result from this reclamation method but the changes will be slow and will not present immediate serious problems. (Steinhilber-USGS) W69-02680

SALT WATER INTERFACE IN A LAYERED

COASTAL AQUIFER, State Univ. of New York, Buffalo. Ralph R. Rumer, and J. C. Shiau. Water Resources Res, Vol 4, No 6, pp 1235-1247, December 1968. 13 p, 14 fig, 10 ref.

Descriptors: \*Saline water-freshwater interfaces, \*Aquifers, \*Coasts, \*Anisotropy, Steady flow, Mathematical models, Dupuit-Forchheimer theory, Darcys law.

Identifiers: Isotropic nonhomogeneous aquifers, Anisotropic nonhomogeneous aquifers, Vertical flow components.

The shape and the position of the interface between the seaward flowing fresh water and the underlying salt water in both isotropic and anisotropic nonhomogeneous coastal aquifers were determined. A transformation for the nonharmonic anisotropic layer was introduced so that the governing equations and boundary conditions in the complex potential plane were satisfied. For the nonhomogeneous layers, the homogeneous mathematical models were superimposed under the same dynamical conditions. Solutions of the flow patterns and interface locations are presented in dimensionless form. It was assumed that the aquifers were anisotropic or nonhomogeneous only in the two-dimensional sense. From earlier studies it has been shown that the solutions obtained are valid for both confined aquifers and unconfined aquifers when the length of salt intrusion is greater than the depth of the aquifer. W69-02683

## STEADY DOWNWARD FLOW TO A WATER

Asian Inst. of Tech., Bangkok (Thailand). Anat Arbhabhirama, and Chanaphan Kridakorn. Water Resources Res, Vol 4, No 6, pp 1249-1257, December 1968. 9 p, 6 fig, 5 ref.

Descriptors: \*Unsaturated flow, \*Porous media, \*\*Groundwater recharge, Hydraulic conductivity, Capillary conductivity, Anisotropy, Isotropy, Mathematical models, Model studies, Laboratory tests, Infiltrometers.

Identifiers: Stratified porous media, Homogeneous porous media, Capillary pressure.

A partially saturated zone in a porous medium is usually found above a water table when the rate of downward flow per unit area of cross section is less than the hydraulic conductivity of the porous medium. Theoretical solutions describing the distribution of capillary pressure above the water table during steady downward flow are presented. Experiments were conducted, using water as the wetting fluid and air as the nonwetting fluid, for both homogeneous and stratified media. The experimental results show good agreement with the theory. W69-02684

#### GEOLOGY AND GROUND-WATER RESOURCES OF THE DEER LODGE VALLEY **GROUND-WATER** MONTANA,

Geological Survey, Washington, D. C. R. L. Konizeski, R. G. McMurtrey, and A. Brietkrietz. U S Geol Surv Water-Supply Pap 1862, 55 p, 1968. 8 fig, 2 plate, 5 tab, 33 ref.

Descriptors: \*Water resources, \*Groundwater, \*Montana, Hydrologic data, Aquifer characteristics, Water yield, Specific capacity, Hydrographs, Water wells, Gravimetric analysis. Identifiers: Deer Lodge Valley (Montana), Multi-

Principal aquifers, which are Quaternary alluvium and Tertiary sediments in Deer Lodge Valley, Montana, are described and their water availability evaluated. The alluvium which is relatively thin, yields sufficient water for domestic and livestock uses. Locally, in the civinity of Clark Fork and its major tributaries, well yields of several hundred gallons per minute each are available. The Tertiary sediments which are thick and have a variable permeability, generally yield less than 10 gpm per foot of drawdown to wells. However, because of the great thickness of these sediments, yields of 1,000 gpm are available locally. The most likely areas for obtaining higher yielding wells are the flood plain of Clark Fork and the coalescing alluvial fans of Mill and Warm Springs Creeks. The depth to water in the flood-plain area is generally less than 10 feet, but on the fans and terraces it ranges from 10 to 150 feet. Recharge to the groundwater system is sufficient to permit addi-tional withdrawals of water without excessively lowering the water table. (Steinhilber-USGS)

## GROUND WATER AND MINERAL WATERS OF CZECHOSLOVAKIA,

Geological Survey of Czechoslovakia, Prague. Vlastimil Myslil, and Ondrej Franko. Int Geol Congr. 23d Sess, Prague, No 21 AC, 51 p, 1968. 10 fig, 1 tab, 20 ref.

Descriptors: \*Water resources, \*Groundwater, \*Mineral water, Geohydrologic units, Aquifers, Springs, Water wells, Thermal water, Water supply, Water utilization.
Identifiers: \*Czechoslovakia, \*Hydrogeology.

A survey of the groundwater and mineral water resources of Czechoslovakia is given in a guide book to excursions in the XIII International Geological Congress. The country's largest groundwater reserves are in the Bohemian Cretaceous Basin in thick extensive Sandstone layers. The deeper aquifers are confined and artesian springs yield up to 100 1/sec. Water supplies are used for cities as far away as Prague. Karst water circulation is well developed in Devonian limestones in Moravia. Pleistocene and younger sands and gravels are of hydrogeologic significance only where they directly communicate with streams. The mineral waters of the Bohemian Massif are of several types, some associated with young tectonic fractures in crystalline rocks and some geother-mally heated in sedimentary aquifers. Detailed descriptions of water supply development and

mineral water occurrences are included in 32 excursion locality descriptions. (Knapp-USGS) W69-02689

## A REGIONAL INTERBASIN GROUNDWATER SYSTEM IN THE WHITE RIVER AREA, SOUTHEASTERN NEVADA, Geological Survey, Carson City, Nev. Water

Resources Div.

Thomas E. Eakin.

Water Resources Res, Vol 2, No 2, pp 251-271, 1966. 21 p, 6 fig, 6 tab.

Descriptors: Regional analysis, \*Groundwater basins, \*Nevada, \*Valleys, \*Hydrologic properties, \*Hydrogeology, Groundwater recharge, Discharge (Water), Springs, Hydraulic gradient, Water chemistry, Groundwater movement, Arid lands, Runoff, Carbonate rocks, Precipitation (Atmospheric). Identifiers: Inter-basin groundwater system.

A report is given which describes the general features of a regional groundwater system consisting of thirteen valleys in a part of the Basin and Range province in southeastern Nevada. Although the scope of the report was limited by the reconnaissance nature of investigations on which it was based, virtually all components of the hydrologic system were evaluated. The interbasin groundwater system was identified on the basis of preliminary appraisals of the distribution and quantities of estimated groundwater recharge and discharge within the region, uniformity of discharge of the principal springs, compatibility of potential hydraulic gradient with regional groundwater movement, relative hydrologic properties of major groups in the region, and, to a limited extent, chemical character of water issuing from the principal springs. Principal findings of the study are reported and discussed. (Affleck-Arizona) W69-02757

## RECHARGE DISTRIBUTION DETERMINED BY ANALOG MODEL,

Arizona Univ., Tucson.

W. G. Matlock.

Groundwater, Vol 4, No 3, pp 13-16, July 1966. 4 p, 7 fig, 1 tab.

Descriptors: \*Groundwater recharge, Recharge, Aquifers, Contours, \*Maps, \*Analog models, Arizona, Electrical equipment, Model studies, Groundwater basins, Distribution patterns, \*Spatial distribution, \*Natural recharge.
Identifiers: \*Santa Cruz River basin (Arizona).

A model study of natural recharge in the lower Santa Cruz River basin of southern Arizona was conducted by the Agricultural Engineering Department of the University of Arizona. To determine the spatial distribution of natural ground-water recharge, a two-dimensional passive element electric analog model was used. A groundwater level contour map of the area in its undeveloped condition was drawn using existing records. By varying inputs from known locations of recharge the model was made to duplicate these contours. Recharge distribution as determined by the model was consistent with previous estimates, but no direct correlation was found with the contributing drainage area. (Affleck-Arizona) W69-02758

## PREDICTING RETURN FLOWS FROM IR-RIGATION,

Bureau of Reclamation, Denver, Colo. For primary bibliographic entry see Field 04B. For abstract, see. W69-02762

#### 2G. Water in Soils

SOLUTE DISPERSION IN TWO HAWAIIAN SOILS UNDER SATURATED FLOW,

Hawaii Univ., Honolulu. Water Resources Research Center.

B. G. Cagauan, Jr., L. S. Lau, R. E. Green, and G. Uehara.

Ninth International Congress of Soil Science Trans, Contrib No 6, 1968, Vol 1 Paper 20, pp 185-194, 4 fig, 1 tab, 19 ref.

Descriptors: \*Solute dispersion, Chloride dispersion, Potassium dispersion, Phosphate dispersion, Dispersion in Hawaiian soils, \*Saturated flow dispersion, \*Dispersion theory, Dispersion and adsorption, Breakthrough curves of chloride potassium and phosphate, One-dimensional dispersion in Hawaiian soils, Dispersion and adsorption of solutes in Hawaiian soils.

A study was conducted to investigate the dispersion of chloride, potassium and phosphate in two Hawaiian soils under saturated flow. A dispersion theory based on a solution of Fick's second law of diffusion was used as a mathematical model. Two flow velocities, where diffusion may be neglected, were selected for each test and the dispersion curves were compared as calculated from theory. A parameter of volume, V sub e, occurring at the arrival of one half of initial concentration, was used to fit the data to the theoretical. To a certain extent, V sub e can reflect dispersion with adsorption. In general, the breakthrough curves of the solutes used can be described by the mathematical model. It was suggested that other models be investigated for soils exhibiting strong adsorption (or fixation) of phosphate. (Author) W69-02405

#### INFILTRATION IN THE PUKETURUA EXPERI-MENTAL BASIN.

Ministry of Works, Wellington (New Zealand). Water and Soil Div.

G. J. Blake, G. D. Mallinson, and P. Lykles.

J Hydrol of New Zealand, Vol 7, No 1, pp 38-46,

1968. 9 p, 2 fig, 1 tab, 12 ref.

Descriptors: \*Infiltration, \*Sprinkling, Computer program, International Hydrological Decade, Wettability, Hydrologic properties.

Identifiers: \*New Zealand, \*North Fork infiltrome-

The first program of infiltration measurement on a New Zealand I.H.D. experimental basin is outlined, and the major problems found in the work are briefly discussed. From 1965 to 1967 the North Fork infiltrometer was used extensively in the Puketurua Experimental Basin, Northland, to examine the infiltration characteristics of the soil units present. Field techniques using this instrument are evaluated, and efforts to improve it are sketched. A new computer program for processing the sprinkling-plot data is described, and the data obtained from it are briefly analyzed. (Llaverias-USGS) W69-02492

EARTHFLOWS AND RELATED ENVIRON-MENTAL FACTORS OF EASTERN OTAGO, NEW ZEALAND,

Otago Univ., Dunedin (New Zealand). Dept. of Geography. M. J. Crozier.

J of Hydrol, New Zealand, Vol 7, No 1, pp 4-12, 1968. 9 p, 5 fig, 11 ref.

Descriptors: \*Landslides, \*Environmental effects, \*Loess, \*Earth-Water interfaces, \*Movement, Weathering, Rainfall, Soil moisture, Temperature,

Evaporation, Solifluction, Stress relieving.

Identifiers: \*Discrete earthflow, \*Extensive earthflow, \*Climatic factors, Regolith, New Zea-

Two types of earthflow (landslides) in the loessmantled hills of eastern Otago, New Zealand are described. One is recognized as the discrete earthflow, bounded by distinct shear lines, and the other as an older extensive flow with preglacial characteristics. Minor variations in form are related to water content, depth and sensitivity of the regolith. Climatic factors and their influence on varying rates or movement are discussed, particularly seasonal soil moisture content, temperature, evaporation, and rainfall which influence discrete earthflow on the Otago Peninsula. Correlation coefficients indicate that variations in rate of movement are closely associated with rainfall variations during winter-early spring when evaporation and temperature are lowest and soil moisture is high. The effect of rainfall on rate of movement is not immediate but appears to be delayed by about a week. (Lang-USGS)
W69-02508

CALIBRATION AND EVALUATION OF A WIDE-RANGE GRAVIMETRIC METHOD FOR MEASURING MOISTURE STRESS,

Geological Survey, Denver, Colo. For primary bibliographic entry see Field 07B. For abstract, see W69-02509

AXISYMMETRIC SEEPAGE **THROUGH** HOMOGENEOUS AND NONHOMOGENEOUS POROUS MEDIUMS,

For primary bibliographic entry see Field 02F. For abstract, see . W69-02511

STEADY INFILTRATION FROM A SHALLOW CIRCULAR POND,

Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Plant Industry.

R. A. Wooding.

Water Resources Res, Vol 4, No 6, pp 1259-1273, Dec 1968. 15 p, 8 fig, 1 append, 17 ref.

Descriptors: \*Infiltration, \*Unsaturated flow, \*Porous media, \*Soil water movement, \*Pit recharge, Mathematical models, Stokes law, Darlaw, Hydraulic conductivity, Isotropy, Anisotropy, Infiltrometers.

Identifiers: \*Steady infiltration, \*Pond recharge, Philips method, Tranters method, Semi-infinite porous media, Boundary conditions, Australia.

Steady infiltration from a shallow, circular, inundated area on the horizontal surface of a semi-infinite porous medium is treated by a method of linearization proposed by J. R. Philip. Using this method, Philip retains most of the properties of the nonlinear system but reduces the differential equation to a linear type representing steady diffusion in a steady uniform flow. On the surface of the medium, the boundary conditions are of mixed type although linear. These conditions are reduced to a system of dual integral equations solved by a modification of Tranter's method. Expressions for the distributions of vertical flux density, moisture content, and Stokes' stream function are derived, and numerical values of the last two quantities are illustrated graphically. It is found that the total flux depends almost linearly upon a parameter defined as the logarithmic derivative of the hydraulic conductivity with respect to capillary potential. Curves of mean flux over various fractions of the total source radius for various values of the parameter indicate the importance of incorporating a guard ring in infiltrometer design. W69-02512

SOIL MOISTURE AVAILABILITY FOR TRANS-PIRATION,

Drexel Inst. of Tech., Philadelphia, Pa. F. J. Molz, Irwin Remson, and A. A. Fungaroli. Water Resources Res, Vol 4, No 6, pp 1161-1169, December 1968. 9 p, 4 fig, 1 tab, 16 ref.

Descriptors: \*Soil water movement, \*Evapotranspiration, Mathematical models, Diffusion, Unsaturated flow, Root zone, Soil moisture

A differential equation is presented describing radial flow of soil moisture to a single vertical sink, for instance a root, in an infinite soil mass which is initially at a uniform moisture content. The relationship between moisture content and diffusivity for the soils studied may be represented by an exponential function. A numerical solution of the differential equation is used to determine the soilmoisture flux. The results show that for specific soils the decrease in soil moisture with time occurs mainly in the immediate vicinity of the sink. Moisture flux increases with initial moisture content but is essentially time independent. In natural systems the flux would probably decrease with time because of multiple root interference. At large soilmoisture contents, actual transpiration is limited by and equivalent to potential transpiration. At small soil-moisture contents, actual transpiration is limited by and equivalent to potential soil-moisture availability. W69-02671

DENSITY AND MOISTURE CONTENT MEASUREMENTS BY NUCLEAR METHODS, Research Triangle Inst., Durham, N. C.

For primary bibliographic entry see Field 07B. For abstract, see . W69-02676

MODEL EXPERIMENTS ON FLUID FLOW IN THE TRANSITION ZONE FROM UNSATU-RATED TO SATURATED SOIL,

Bundesanstalt fuer Gewasserkunde, Coblenz,

West Germany).

F. Schwille, W. Lippok, and D. Weisflog.

Proc of Symp, Int At Energy Agency, Vienna, and

Europe Nucl Energy Agency, pp 151-160, 1967. 10 p, 10 fig, Discuss.

Descriptors: \*Infiltration, \*Porous media, \*Alluvium, \*Lysinieters, \*Radioisotopes, Radioactive waste disposal, Groundwater movement, Percola-tion, Seepage, Unsaturated flow, Model studies, Saturated soils.

Identifiers: Homogeneous media, Unsaturated soil.

Lysimeter studies of the infiltration of water into soil were made in a study of the safety factors of radionuclide-producing plants located on river al-luvium in Germany. More than four-fifths of the drinking water in Germany is groundwater or bankfiltered river water. The most important aquifers in the Federal Republic of Germany are fluviatile and fluvioglacial Pleistocene sand and gravel deposits, situated in the valleys of the large rivers. The ground-water level is generally from 3 to 15 m below ground surface. Depending on the permeability of the substrata, about 100 to 300 mm of precipitation water probably infiltrates. These alluminations are supported by the substrate free discountries. vial plains are possible locations for radionuclideproducing plants. However, it is hard to find any locality where such plants would not have a marked effect on the water supply system. To protect groundwater against radionuclide contamination, a detailed knowledge is first necessary of the migra-tion mechanisms of radionuclide-containing solutions both into the unsaturated zone and the saturated zone. Infiltration in the unsaturated zone and spreading in the saturated zone were analyzed with sand models. Large glass lysimeters, experimental troughs with glass walls and small diameter copper and glass segment-tubes were used as models. The and glass segment-tubes were used as models. The liquid fronts were traced mainly with ultra-violet light. The result shows that it is not yet possible to treat the flow of liquid analytically in every case, even in homogeneous media. (Knapp-USGS) W69-02681

STEADY DOWNWARD FLOW TO A WATER TABLE,

Asian Inst. of Tech., Bangkok (Thailand). For primary bibliographic entry see Field 02F. For abstract, see . W69-02684

## Field 02 - WATER CYCLE

## Group 2G-Water in Soils

CIRCULATION OF WATER IN SOIL UNDER A

TEMPERATURE GRADIENT,
Agricultural Research Service, Tempe, Ariz. Water Conservation Lab.; and Rothamsted Experimental

Station, Harpenden (England). R. D. Jackson, D. A. Rose, and H. L. Penman. Nature, Vol 205, No 4968, pp 314-316, January 16, 1965. 3 p, 3 fig.

Descriptors: Arid lands, \*Soil water movement, \*Thermocline, \*Saline soils, \*Water vapor, Salts, Temperature, Circulation, Equilibrium, Soil dynamics, \*Transfer. Identifiers: Soil column, Circulatory system,

Fluxes, Vapor, Non-saline soils.

An experiment was designed to show that when a temperature gradient is applied to a uniform closed soil column, a circulatory system is set up and that any eventual steady moisture distribution is ac-tually a dynamic balance of opposing fluxes, predominantly vapor from hot to cold and predominantly liquid from cold to hot. Saline and non-saline soils were tested. For both materials there was a net water movement from hot to cold, the movement being greater in the absence of salt. When a temperature gradient was applied along a column in which water and salt were initially uniformly distributed, two kinds of transfer were possible. There was a vapor flux moving from hot to cold, and a return liquid flux from cold to hot, indicating that a circulatory system was in effect in the soil. The temperature gradient of arid soil had a direct influence on circulation of water in the soil. (Blecker-Arizona) W69-02752

THE EFFECTS OF SOIL MOISTURE STRESS ON THE GROWTH OF BARLEY: IV. THE RESPONSE TO PRESOWING TREATMENT,

Adelaide Univ. (Australia). Waite Inst. I. Husain, L. H. May, and D. Aspinall. Aust J Agric Res, Vol 19, No 2, pp 213-220, March 1968. 8 p, 4 tab.

Descriptors: Plant physiology, \*Soil moisture, \*Barley, \*Moisture stress, Germination, Drying, Wetting, \*Plant growth, Leaves, Resistivity, Turgidity, Lysimeters, \*Crop response, Treatment, Soil-water-plant relationships. Identifiers: Presowing treatment.

The claim that a presowing treatment, consisting of two cycles of wetting and drying, reduces suscepti-bility of barley to effects of water stress during growth was investigated. Barley grain was thoroughly mixed with water equivalent to 30% of its air-dry weight. The moistened grain was allowed to germinate in a saturated atmosphere at approximately 20 deg C for 48 hours. The damp grain was then spread out and dried down to its original weight. This cycle was repeated once, the grain being allowed to germinate for 24 hours only on the second occasion. Apart from a 15% increase in grain size on plants subjected to water stress late in development, no persistent effects of treatment were found, and no evidence to support claims of increased yield under water stress conditions. Possible reasons for the evident difference between these data and those of other studies were discussed. (Affleck-Arizona) W69-02759

**EFFECTS OF VERTICALLY HETEROGENOUS** SOIL SALINITY ON PLANT GROWTH AND

WATER UPTAKE,
California Univ., Riverside.
For primary bibliographic entry see Field 021. For abstract, see . W69-02761

EFFECT OF BARE FALLOW, BARLEY, AND GRASS ON SALINITY OF A SOIL OVER A WATER TABLE, Fred M. Sandoval, and L. C. Benz. Soil Sci Soc Amer Proc, Vol 30, No 3, pp 392-396, May-June 1966. 5 p, 4 fig, 6 tab.

Descriptors: \*Saline water, \*Saline soils, Salinity, Descriptors: \*Saline water, \*Saline soils, Salinity, \*Leaching, \*Water table, Fallowing, Precipitation (Atmospheric), Rotations, Evapotranspiration, Evaporation, North Dakota, Barley, Soil moisture, Moisture tension, Groundwater, Soil chemical properties, Grasses, Crop response, lons. Identifiers: Perennial grasses.

A study was conducted in North Dakota to compare effects of bare fallow, perennial grass and bar-ley culture on salinity of land affected by a highly saline, shallow water table that ranged in depth from 0.5 to 3 meters. Water levels were usually closest to the surface under fallow, followed by small grain and grass in that order. Salt concentration of the shallow groundwater remained fairly constant as indicated by electrical conductivity. Short-period leaching was more effective under grass than the other treatments. Precipitation in excess of evaporation supplied water for leaching of soluble soil salts under fallow. Under cropping, evapotranspiration left little excess water leaching. Salinity may increase near the surface when a crop with high evapotranspiration like grass is grown in the presence of a saline shallow water table. Bare fallow in a cropping rotation where weeds are controlled and a shallow soil mulch is maintained on the surface, may have merit in the management of saline nonirrigated soils in arid cli-mates, permitting the use of natural rainfall to reduce salinity in the root zone. (Blecker-Arizona) W69-02768

#### 2H. Lakes

BOTANICAL AND CHEMICAL CHARAC-TERISTICS DURING THE FALL OVERTURN OF A SMALL EUTROPHIC LAKE, PRETTY LAKE, INDIANA,

Geological Survey, Fort Wayne, Ind. Robert G. Lipscomb. U S Geol Surv Prof Pap 500-B, pp B204-B208, 1966. 6 p, 5 fig, 1 tab, 3 ref.

Descriptors: \*Limnology, \*Turnover, Eutrophication, Lakes, Indiana, Thermal stratification, Phytoplankton, Cyanophyta, Chlorophyta, Diatoms, Indicator organisms, Hydrogen ion concentration, Hydrogen sulfide, Dissolved oxygen.
Identifiers: Pretty Lake, Glacial lakes, Kettle hole lakes, Aphanizomenon, Asterionella, Fragileria, Cyclotella, Melosira.

Five monthly samples (28 August - 15 December 1963) from a small glacial lake in Indiana show that patterns of phytoplankton distribution, dissolved-oxygen concentration, and pH were in close harmony with thermal stratification of the water and with erasure of the stratification. Algal species be-longing to the Chlorophyceae, Baccillariophyceae, and the Myxophyceae were dominant phytoplank-ton during late stages of the stratification. Author expresses abundance of phytoplankton as percentage concentration. Species of blue-green algae were dominant as 60% of population in August and decreased to a low of 5% after turnover (15) December). Species of green algae continued at rather low levels of abundance throughout the period of study but attained peak abundance (7%) at sampling of 15 November, at which time bluegreens constituted 47% and diatoms, 40%. By mid-December, after erasure of the stratification, the phytoplankton population had increased considerably and was dominated by winter species of diatoms (90%), whereas blue-greens constituted only 5%. W69-02409

EUTROPHICATION OF WATER RESOURCES
OF NEW YORK STATE. A STUDY OF
PHYTOPLANKTON AND NUTRIENTS IN
LAKES CAYUGA AND SENECA,
New York State Coll. of Agriculture, Ithaca.
Daniel H. Hamilton.

Cornell University Water Resources Center, Publication No. 14, November 1966. 22 pp, 12 tab, 6 fig, 10 ref. OWRR Project A-007-NY.

Descriptors: Nutrients, Eutrophication, Lake stages, Opacity.

The distribution of phytoplankton pigments, nitrates and phosphates in the large deep Cayuga and Seneca Lakes was measured during the summer of 1965. The phytoplankton standing crops indicate that these lakes are now relatively fertile; maximum pigment values were about 20 mgm Chl A per cubic meter. The only parameter aside from temperature that could be compared with earlier studies was transparency, measured by Secchi disc, which showed a very distinct decrease from about 10 M in the earliest measurements about 50 years ago to about 3 M. There is some evidence that transparency may have decreased most rapidly in the last two decades. Nitrate levels are relatively high, but phosphate remains very low, less than 0.5 microgram at. per liter. Possible sources of nutrient enrichment are discussed. (Bar-W69-02488

CIRCULATION AND MIXING PROCESSES IN

Wisconsin Univ., Madison. Water Research Center.

R. A. Ragotzkie, and J. A. Hoopes. Tech Comp Rept for OWRR Project A-004-Wis, Water Research Center, 1968. 16 p.

Descriptors: Lake Superior, Coriolis force, Infrared radiometry, Wind shear, Lake circulation, Thermal stratification, Seiches, Laboratory models.

Through the combined efforts of this field, laboratory, and theoretical study, quantitative models and data, regarding certain features of the circulation of Lake Superior are known. The most significant result is the tendency for strong and relatively narrow boundary currents to occur along the perimeter of Lake Superior and the other Great Lakes as well. Airborne studies, confirmed by ship and buoy measurements, have shown that the Keweenaw Current (a north-eastward flowing current along the Keweenaw Peninsula) occurs from late June through early October with a velocity of 1 knot. Airborne infrared measurments have also shown the presence of two, large cold cells in the eastern end of the lake. From the theoretical models, the existence of a strong, nearshore, boundary current around the whole Lake is predicted; field observations support this result. Laboratory model studies in a rotating model os the Lake support the field and theoretical observations and provide a physical analog of the Lake circulation. W69-02489

NOCTURNAL HEAT LOSS OF A LAKE AND SEASONAL VARIATION IN ITS VERTICAL THERMAL STRUCTURE,

Toronto Univ. (Ontario). Dept. of Mathematics. D. V. Anderson.

Bull Int Assoc Sci Hydrol, Vol 13, No 3, pp 33-40, Sept 1968. 8 p, 4 fig, 12 ref.

Descriptors: \*Limnology, \*Thermocline, \*Water temperature, \*Heat budget, \*Diurnal, Convection, Cooling, Lake Ontario, Thermal stratification, Water circulation.

Identifiers: \*Nocturnal heat loss, Vertical thermal

A synthetic diurnal energy budget averaged for cach month of the year shows that Lake Ontario loses very little heat at night during April, May, and June. The nightly losses during July, August, and September are conjectured to contribute significant because its contribute significant for the contribute of the contribute significant for the contribute sig cantly to the deepening of the thermocline through vertical convection. In summary, convection by nocturnal cooling must be considered along with wind mixing as important in controlling the thermal structure of large lakes. (Knapp-USGS) W69-02507

#### A CATALOG OF CHEMICAL ANALYSES OF LAKE WATER SAMPLES 1925-1966.

Wisconsin Conservation Dept., Madison, Fish Management Div. Ronald J. Poff.

Wisconsin Conserv Dep. Fish Manage Div, Feb 6, 1967.41 p.

Descriptors: \*Lakes, \*Limnology, \*Data collections, \*Wisconsin, \*Chemical analysis, Eutrophication, Water quality, Water chemistry, Nutrients, Water properties, Soil type, Oligotrophy, Data processing, Data storage and retrieval, Geologic formations, Glaciation, Dolomite.

Identifiers: Upper Cambrian sandstone, Superior sandstone, Pre-Cambrian igneous, Reddish clay loams, Sands, Grayish yellow silt loams, Sandy loams, Grayish brown glaciated silt loams, Grayish brown unglaciated silt loams, Pink loams, Driftless areas, End moraines, Ground moraines, Lake basins, Pitted outwash, Unpitted outwash, Grayish and sandy loams.

From archival sources and current determinations carried out in the laboratories of his own agency, author has assembled a data bank for chemical analyses of 1282 samples from 928 lakes of Wisconsin. Data have been stored, retrieved and printed by electronic data processing techniques. Presentation includes the following items of data: county number, lake identification, date, sample source, data source, specific conductance (micromhos/cm at 25 deg Celsius), pH, total alkalinity (mg/liter as calcium carbonate), CALCI-UM, MAGNESIUM, SODIUM, POTASSIUM, TOTAL IRON, ORGANIC Kjeldahl nitrogen, ammonia as nitrogen, nitrate as nitrogen, total phosphate by nitric/perchloric acid digestion, dissolved phosphates, chlorides, and sulphates. in all cases, results are in units of milligrams/liter except where otherwise noted above. Provisions have been made to update the data bank, and author indicates that 300 analyses are on file which have not been incorporated in the presentation. Preliminary analysis of treatment means for 15 items of analyses have been presented for treatment according to geological province (5 categories), glacial province (7 categories), and soil province (9 categories). W69-02522

#### PRIMARY PRODUCTION IN LAKES,

Bowling Green State Univ., Ohio. Dept. of Biology. Jacob Verduin.

Limnol Oceangr, Vol 1, pp 85-91, 1956. 7 p, 2 fig, 2 tab, 17 ref, disc.

Descriptors: \*Lakes, \*Carbon cycle, \*Primary productivity, \*Phytoplankton, \*Photosynthesis, Limnology, Light penetration, Lake Erie, Instrumentation, Eutrophication, Oligotrophy, Wisconsin, Colorado, Kansas, Pennsylvania, Comparative productivity, Diatoms, Seston, Chlorophyll, Esti-mating equations.

Identifiers: Helmet Lake (Wis), Trout Lake (Wis), Crystal Lake (Wis), Muskellunge Lake (Wis), Weber Lake (Wis), Nebish Lake (Wis), Scaffold Lake (Wis), Pymatuning Reservoir, Georges Bank, Sandusky Bay, Allens Lake (Colo), Base Line Lake (Colo), Haydens Lake (Colo), Beasly Lake (Colo), Gaynor Lake (Colo), Boulder Lake (Colo), Kossler Lake (Colo), Secchi disk, Autotrophy, Euphotic zone.

Limnological data from the literature and author's research yield mean photosynthetic rates for lacustrine phytoplankton under optimal light (natural conditions) of about 0.5 micromoles (oxygen evolved or carbon dioxide consumed)/microliter of organisms/hour; 1-2 micromoles/milligram ash-free dry weight/hour; and 0.2 micromoles/microgram chlorophyll/hour. For lakes with epilimnetic euphotic zone, equation for estimating daily photosynthesis/square meter of water (Y sub a) is: (Y sub a) = (P sub v) (Y sub p) (D sub 1) (0.65), where (P sub v) = mean phytoplanktonic crop/cubic meter in euphotic zone; (Y sub p) = daily photosynthesis/unit standing crop under optimal light; (D sub 1)= depth of euphotic zone. For lakes

with hypolimnetic euphotic zone or where bottom receives more than 1% of surface light, equation is: (Y sub a) = (P prime sub v) (Y sub p) (D sub 2);where (P prime sub v) = mean phytoplanktonic crop in epilimnion; (D sub 2) = depth to midthermocline or to bottom in unstratified lakes. For seven Wisconsin lakes, yields (millimoles/sq meter/day) calculated from these equations range from 56 (Trout L) to 325 (Scaffold L), compared with range of 47 (Helmet L) to 146 (Scaffold L) estimated by more tedious method described elsewhere in literature. Ten similar computations for waters of Kansas, Colorado, and L Erie yielded mean value of 196.Q, with range 122 (Kossler L, Colo) to 450 (Gaynor L, Colo). W69-02523

## THE USE OF RIBONUCLEIC ACID IN ZOOPLANKTON AS AN INDEX OF BIOLOGICAL PRODUCTIVITY IN FRESH WATER LAKES,

Wisconsin Univ., Madison. Dept. of Zoology. John S. Bjerke. MS Thesis, 1962. 80 p.

Descriptors: \*Lakes, \*Zooplankton, \*Secondary Descriptors: "Lakes, "Zooplankton, "Secondary productivity, Comparative productivity, Daphnia, Biological productivity, Wisconsin, Bioindicators, Analytical techniques, Trophic level, Eutrophication, Oligotrophy, Growth stages, Proteins, Metabolism, Bioassay.

Identifiers: \*Productivity indices, Lake Mendota (Wis), Lake Monona (Wis), Lake Waubesa (Wis), Lake Mary (Wis), Pine Lake (Wis), Stewart's Dark Lake (Wis), Little John Lake (Wis), Erickson Lake (Wis), Trout Lake (Wis), Allequash Lake (Wis), Cather Lake (Wis), Nucleic acid, Ribonucleic acid, Daphnia schodleri.

Author presents modification of a previously described method for estimating ribonucleic acid ribose by the orcinol reaction, making possible the estimation of ribonucleic acid (RNA) for as few as 50 Daphnia. Content of RNA (expressed as percentage of dry weight) decreases as Daphnia grows. RNA content decreases from 10.33%, for animals with mean length of 1.0 mm and mean weight of 5.4 micrograms, to 4.31%, for those with mean length of 2.24 mm and mean weight of 26.2 micrograms. Contents of brood pouch also influence RNA content. Two samples each of following types yielded the following results: empty brood pouch, 5.79%; eggs in pouch, 4.82%; with embryos, 7.01%; and with nauplii, 6.32%. A total of 58 samples, from 11 Wisconsin lakes representing a variety of trophic types, were analyzed. For 5 samples from eutrophic Lake Mendota, RNA content increased for all size classes during the period, June - October 1961. If RNA content is interpreted as indicative of rate of protein synthesis, author asserts that his data are compatible with hypothesis that such analyses may be used as assay for biological production. He stresses the need for further research. W69-02524

# PRELIMINARY WATER BALANCE STUDIES OF THE ROTORUA LAKES, Ministry of Works, Hamilton (New Zealand).

R. J. Pittams.

J of Hydrol (New Zealand), Vol 7, No 1, pp 24-37, 1968. 14 p, 2 fig, 5 tab, 3 ref.

Descriptors: \*Water balance, \*Lake basins, Lakes, Seepage, Rainfall, Evapotranspiration, Limnology, Outlets.

Identifiers: \*Lake level changes, \*Outflows, Groundwater storage, New Zealand, Rotorua

Rainfall, evapotranspiration, groundwater storage, outflow, and lake levels for Lakes Rotoma, Rotoehu, Rotorua, and Rotoiti, in the Rotorua-Bay of Plenty area of the North Island of New Zealand was studied quantitatively. All basic relationships were investigated using data from Lake Rotoma, and the annual water balances for the various lakes are compared with data on Lake Rotoma. This study is of interest since it involves lakes with no open outlet (Lake Rotoma, and Rotoehu), water loss through seepage and underground flow, and the response of lake levels to rainfall. Pertinent tabular data accompany an exposition of the study results. (Llaverias-USGS) W69-02675

#### THE USE OF OXYGEN 18 AND DEUTERIUM CONCENTRATIONS IN THE WATER BALANCE OF LAKES.

International Atomic Energy Agency, Vienna (Austria).

Water Resources Res, Vol 4, No 6, pp 1289-1306, December 1968. 18 p, 9 fig, 8 tab, 27 ref.

Descriptors: \*Deuterium, \*Oxygen, \*Tracers, \*Lakes, \*Water balance, Evaporation, Precipita-tion (Atmospheric), Hydrologic budget, Inflow. Identifiers: Turkey, Oxygen isotopes

Natural concentrations of stable isotopes of hydrogen and oxygen are used to determine the water balance of lakes situated in a subhumid climate in southwestern Turkey. A salt lake in that region is used as an index to the molecular exchange process between the lake and the atmospheric moisture. Such use of stable isotopes of oxygen and hydrogen in water balance studies appears to yield promising results and indicates that environmental isotopic studies might be a useful tool in limnological studies. Oxygen-18 is plotted against deuterium in precipitation, spring, and lake samples in the Antalya-Konya regions. Isotopic compositions of the lakes are tabulated and mapped. W69-02685

## LIMNOLOGICAL EFFECTS OF ORGANIC EXTRACTS OF LITTER IN A SOUTHWESTERN IMPOUNDMENT,

Arizona Univ., Tucson. Cooperative Fishery Unit. William J. McConnell.

Limnol and Oceanogr, Vol 13, No 2, pp 343-349, April 1968. 7 p, 1 fig, 4 tab, 16 ref.

Descriptors: \*Limnology, \*Aquatic productivity, \*Fish, \*Nutrients, \*Leaves, Leaching, Oak trees. Identifiers: Pena Blanca Lake (Arizona).

Watershed litter in semiarid southeastern Arizona is relatively unleached, and the accumulation of a year or more is occasionally delivered to lakes within the first few days of the summer rainy season. Pena Blanca Lake received at least 750 g/sq m of oak litter during the summer of 1959. About 329 kg cal/sq m were delivered to the lake in oak litter extracts of which 26% were probably from carbohydrates, 54% from phenolic compounds, and 20% from unidentified compounds. Oak leaf extracts were experimentally effective as an energy source for microorganisms used as food by filter-feeding organisms (Xenopus laevis) and snails. Efficiency of the extract-microorganisms-Xenopus and snail food chain was 3.28%. Based on an estimated ecological efficiency of 0.56% for the food chain: litter extract-microorganisms-zooplankton-young Micropterus salmoides, Micropterus biomass production may have been increased 0.4 g/sq m to the second power by organic components in oak litter extracts contributed to Pena Blanca Lake in 1959. This increase represents 16.7% of the average annual fish harvest for 1959, 1960, and 1961. W69-02687

## LAKE ERIE REPORT: A PLAN FOR WATER POLLUTION CONTROL, Federal Water Pollution Control Administration,

Washington, D. C.

For primary bibliographic entry see Field 05C. For abstract, see. W69-02695

## **Group 2H—Lakes**

THE SEASONAL VARIATION OF PHOSPHATE, SILICATE, AND NITRATE IN WATERS OF THE ENGLISH LAKE DISTRICT,

Freshwater Biological Association, Ambleside (England).

I Heron

Limnol Oceanogr, Vol 6, pp 338-346, 1961. 9 p, 5 fig, 10 ref.

Descriptors: \*Eutrophication, \*Phosphates, \*Silicates, \*Nitrates, \*Nutrients, \*Water pollutions icates, \*Nutrates, \*Nutrients, 'water poliutions sources, \*Water pollution effects, Diatoms, Spectrophotometry, Water quality, Water chemistry, Agricultural chemicals, Agricultural watersheds, Analytical techniques, Mud-water interfaces. Identifiers: Melosira English Lake District, Lake Windermere, Esthwaite Water, Blelham Tarn, Asterionella

Asterionella.

Author publishes data for rainfall; temperature, at surface and bottom; total diatom population; and changes in concentration of nitrate-nitrogen, phosphate-phosphorus, and silicon, derived from weekly sampling of four basins (north and south basins of Lake Windermere, Esthwaite Water, Blelham Tarm) of the English Lake District from January 1958 to March 1960. A more sensitive analysis for phosphate is described. Chemical water quality of the lakes are influenced by geological charac-teristics of the drainage basin and by relationship of the basins, one to the other. Total ionic concentration for north basin of Windermere averages 0.51 milli-equivalents/liter; for south basin, 0.55; for Esthwaite Water, 0.75; and for Blelham Tarn, 0.80. Graphs indicate a marked correlation between rainfall and increase in phosphate concentrations in surface water. Author asserts that, as a source of phosphate, exchange at the mud-water interface is greatly outweighed in importance by application of fertilizers to agricultural land in the drainage basin. Increased concentrations of phosphate during summer months may result from temporary enrichment due to heavy rainfall, release of phosphate from algal cells after blooms, and contamination by zooplankton excreta. Erratic temporal variations of nitrate are described but not exlained.

W69-02786

## THE SEASONAL AND DIEL CHANGES IN DIS-TRIBUTION OF DIAPTOMUS LEPTOPUS IN A SMALL EUTROPHIC LAKE,

British Columbia Univ., Vancouver. Dept. of

Zoology. M. C. Healey.

Limnol Oceanogr, Vol XII, No 1, Jan 1967. 6 p, 1 fig, 4 tab, 11 ref.

Descriptors: \*Eutrophication, \*Indicator organisms, \*Copepods, \*Vertical migration, Lakes, Limnology, Seasonal, Diurnal, Distribution, Distribution, tion patters, Behavior, Animal behavior, Variability, Sampling, Digital computers, Computer programs, Growth stages, Diel migration.

Identifiers: Lake Corbet (B C), British Columbia

(Canada), Diaptomus leptopus, Clarke-Bumpus sampler, Aggregation, Fisher's coefficient of dispersion, Analysis of variance, Wisconsin net.

Studied during June-September 1963, populations of Diaptomus leptopus in eutrophic Corbet Lake, British Columbia, displayed differences in migratory behavior among age groups. Populations of the copepod were sampled monthly with a Clarke-Bumpus sampler from 13 depths at a single station. In addition, a series of vertical hauls with a Wisconsin net (No 10 mesh) were made at several widely spaced stations. Samples so collected were counted by groups as juveniles (stages I-IV) and adult males and females (stages V-VI). Resultant numbers were subjected to a three-way analysis of variance (depth by month by time of day). Fisher's dispersions were fisher to efficient. (depth by month by time of day). Fisher's dispersion coefficient (sample variance/sample mean) was used as an index of degree of vertical and horizontal aggregation (clumping). Only adult males showed significant vertical migration. Adult females and juveniles demonstrated diel changes in vertical migration, but not consistently between

samples. All three groups were significantly clumped vertically, and the data suggest that such clumping is related to population size. There was some evidence for horizontal patchiness. Author emphasizes the possibility that ontogenetic changes in migratory behavior provide new clues to the biological significance of vertical migration.

W69-02789

## NITROGEN FIXATION AND THE UTILIZA-TION OF OTHER INORGANIC NITROGEN SOURCES IN A SUBARCTIC LAKE,

Alaska Univ., College, Inst. of Marine Science. Vera A. Billaud.

J. Fish. Res. Bd. Canada, Vol 25, No 10, pp 263-269, October 1968. 10 p, 5 fig, 18 ref.

Descriptors: \*Nitrogen cycle, \*Nitrogen fixation, Subarctic, Limnology, Alaska, Ammonia, Nitrates, Stable isotopes, Ammonification, Nitrification, Denitrification, Anaerobic conditions. Identifiers: Nitrogen utilization.

The relative nutritional importance of ammonia, nitrate and molecular nitrogen in a subarctic lake was investigated using the stable isotope nitrogen-15 as a tool to determine uptake ratios. These data were correlated with the chlorophyll, particulate nitrogen and phytoplankton organisms present on a year-round basis. Quantitative determinations of nitrogen nutrient concentrations were also carried out. Ammonia was consistently the most important nitrogen source, and of the two main algal production periods, the first early spring population under ice depended exclusively on this source. The second spring population, dominated by Anabaena flos-aquae, used ammonia, nitrate, and molecular nitrogen simultaneously. During much of the summer, low uptake ratios prevailed with ammonia the principle source, although during the fall nitrate uptake briefly approached the magnitude of ammonia uptake. W69-02795

## VERTICAL CURRENT STRUCTURE IN THE GREAT LAKES, Michigan Univ., Ann Arbor.

Vincent E. Noble, Joseph C. Huang, and James H.

Special Report No. 37, Great Lakes Research Division, University of Michigan, 1968, 94 p. FWPCA Grant WP-01067.

Descriptors: Lake Michigan, Convection, Water circulation, Eddies, Diffusion, Water currents. Great Lakes, Stratification, Thermal properties.

During a two-year program to study the threedimensional structure of the currents of Lake Michigan, experiments have been carried out to describe the circulation dynamics of Lake Michigan. Two closely-spaced current meter station records have been compared with local wind data and have shown that there is not a simple response of the currents to the wind field. Aerial thermal surveys of the total lake basin, when com-pared with BT transects have indicated a largecale, seasonal circulation pattern in the lake basin. Theoretical models of the spring warming period of the lake predict circulation patterns that are consistent with field measurements, and that indicate that thermal, geostrophic forces may define the basic circulations of the lake. Additional considera-tion of Stern's model of the effects of wind on geostrophic vortices supports the hypothesis that the effect of wind stress upon the lake basin is a perturbation of the geostrophic circulation field, particularly in the spring and fall of the year. W69-02797

## 2I. Water in Plants

#### SALT ENTRY INTO PLANTS.

Agricultural Research Service, Beltsville, Md. Mineral Nutrition Lab. Sterling B. Hendricks.

Soil Sci Soc Amer Proc, Vol 30, No 1, pp 1-7, January-February 1966. 7 p, 8 fig, 38 ref.

Descriptors: Metabolism, Saline soils, \*Transloca-tion, \*Root systems, \*Salts, Soil-water-plant relationships, Hydrogen ion concentration, cal studies, Absorption, Plant morphology, Plant tissues, Infiltration, Ions, Anion exchange, Equilibrium, Cation exchange. Identifiers: Salt entry, Salt transport.

The manner of salt entry into roots and salt transport within the plant were discussed in this paper. The plasmalemma was a major barrier preserving integrity of the cell, serving to limit leakage of salts, sugars, acids and other materials from plants to water. The exceedingly quick response of salt uptake to changes in external conditions such as pH, and the action of inhibitors indicated that the plasmalemma of epidermal cells was the chief barplasmalemma of epidermal cells was the chief bar-rier to salt passage. If the coupling of substrate ox-idation to molecular oxygen was inhibited, adenosine triphosphate (ATP) production and salt uptake by the root were proportionately inhibited. A scheme for salt transport through the plasmalem-ma was shown. Salt not only entered the root but moved from the root to the soil solution. The distinction made by the plant between potassium and sodium was discussed. In salt accumulation, if transport from the roots was limited, an eventual equilibrium was reached with equal efflux and in-flux rates. (Blecker-Arizona) W69-02747

## NITROGEN FERTILIZER AND WHEAT IN A SEMI-ARID ENVIRONMENT 2. CLIMATIC FACTORS AFFECTING RESPONSE,

Commonwealth Scientific and Industrial Research Organization, Brisbane (Australia). Cunningham Lab

J. S. Russell.

Aust Jour Exp Agr and Animal Husb, Vol 8, No 31, pp 223-231, April 1968. 9 p, 4 tab.

Descriptors: \*Climatic data, \*Nitrogen, \*Fertilizers, Wheat, Semiarid climates, Temperature, \*Regression analysis, Rainfall, Variability, Monthly, Diurnal, Evaporation, \*Crop response.

A study was conducted of climatic factors influencing the yield response of wheat to nitrogen fertilizer in semi-arid areas of South Australia. The dependent variables were linear and quadratic coefficients obtained by fitting orthogonal polynomials to the response curves of various parameters to nitrogen fertilizer in 52 experiments during 1956-1961. Independent variables were the following climatic characteristics: daily rainfall, evaporation, and temperature. Relationships between these dependent and independent variables were examined by multiple regression analysis. Climatic factors contributed significantly to the regression of all linear and quadratic coefficients examined. Positive effects of increasing amounts of rainfall on yield response during the preheading period were evident. On the other hand, the negative effects of high temperatures in the latter part of the growing season were also marked. The final response appears to be the resultant of these two main effects.
(Affleck-Arizona) W69-02748

# EFFECT OF RESTRICTED ACCESS TO WATER ON THE INTAKE OF SALTY FOODS BY MERINO AND BORDER LEICESTER

SHEEP,
Commonwealth Scientific and Industrial Research Organization, Riverina (Australia). Riverina Lab. A. D. Wilson, and N. L. Hindley. Aust J Agric Res, Vol 19, No 4, pp 597-604, July

1968. 8 p, 1 fig, 5 tab.

Descriptors: \*Sheep, \*Sodium chloride, \*Diets, Digestion, Water requirements, Animal physiology, Moisture stress, Semiarid climates, \*Urine, Foods, Feeding rates, \*Water balance. Identifiers: \*Saltbush (Australia), \*Restricted access, \*Water intake.

## Erosion and Sedimentation—Group 2J

A study was conducted in Australia in which sheep were fed on diets containing 7.5, 11.25, and 15% added sodium chloride to simulate diets containing up to 100% saltbush (Atriplex sp). All experiments were conducted indoors in the cool weather so that changes in water intake were attributable to the treatments imposed. There was a reduction in food intake when access to water was restricted to once daily, the reduction being more severe with the more salty diets. Merino sheep drank 5.0 1/day and Border Leicester sheep drank 7.6 1/day when fed on the diet containing 15% sodium chloride and when their access to water was restricted to once daily. The Border Leicesters ate 22% more food than the Merinos. It was concluded that Merino sheep will need to drink more often than once daily when their water intake exceeds 51/sheep/day, and that this would occur when the saltbush intake reached 500-600 g/day. (Affleck-Arizona) W69-02750

THE NATURE OF THE PERENNIAL RESPONSE IN MEDITERRANEAN GRASSES: II. SENESCENCE, SUMMER DORMANCY, AND SURVIVAL IN PHALARIS,

Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Plant

Industry.
J. R. McWilliam.

Aust J Agric Res, Vol 19, No 3, pp 397-409, May 1968. 13 p, 4 fig, 2 tab.

Descriptors: \*Grasses, \*Crop response, Drought resistance, Summer, \*Life cycles, Plant growth, \*Moisture stress, Root systems, \*Photosynthesis, Plant physiology, Carbon cycle, Translocation, Growth stages.

Identifiers: Perennial grasses, Annual grasses, \*Senescence, \*Dormancy, \*Buds.

Adaptation to summer drought has been one of the major factors influencing the life cycle of the Mediterranean grasses. A study was made of the phenomena of senescence and bud dormancy, and the fixation and movement of carbon assimilates under simulated conditions of a summer drought. A typical perennial, Phalaris tuberosa, was compared with a closely related annual species, P minor. One of the most important factors controlling the plant survival of these two species was the difference in the rate and pattern of senescence after flowering under the influence of moisture stress. In the annual, senescence was rapid and complete, but in the perennial it was retarded, and function was retained in certain organs, including the lower stem and root system, throughout the summer stress. This permitted survival of dormant buds which contained the meristems vital for regrowth in the autumn. (Affleck-Arizona)
W69-02754

THE NATURE OF THE PERENNIAL RESPONSE IN MEDITERRANEAN GRASSES: I. WATER RELATIONS AND SUMMER SURVIVAL IN PHALARIS, Duke Univ., Durham, N. C. Dept. of Botany. J. R. McWilliam, and P. J. Kramer.

Aust J Agric Res, Vol 19, No 3, pp 381-395, May 1968. 15 p, 6 fig, 2 tab.

Descriptors: Arid climates, Nutrients, Water balance, \*Grasses, Drought tolerance, Soil moisture, Soil-water-plant relationships, \*Root systems, Water loss, \*Crop response, \*Moisturestress, Plant physiology, On-site investigations, Absorption, \*Summer, Transpiration, Plant growth, Wilting point.

Identifiers: Perennial grasses, Annual grasses, Dormancy, Stems.

The water relations of a typical mediterranean perennial grass, Phalaris tuberosa L, were studied both in the field and in a controlled environment under conditions of a simulated summer drought. It was found that an important factor in the survival of this perennial was the ability of its deep root system to supply water during the summer to the dormant culms at the soil surface. In contrast the

related annual P minor was unable to exploit subsoil moisture and died as soon as the surface moisture was exhausted. During the summer stress the volume of water supplied by the perennial roots was sufficient to offset transpiration losses and maintain a favorable water balance in the dormant culms. Roots of the perennial were followed to a depth of 7 feet in subsoil containing available moisture. The large metaxylem vessels and heavily suberized endodermis of the roots suggested that they were well adapted to transporting water up through the dry surface soil to the base of the dor-mant culms. (Affleck-Arizona) W69-02755

STUDIES ON SALT TOLERANCE OF SHEEP: VII. THE TOLERANCE OF EWES AND THEIR LAMBS IN PENS FOR DRINKING WATERS OF THE TYPES OBTAINED FROM DERGROUND SOURCES IN AUSTRALIA

Commonwealth Scientific and Industrial Research Organization, Adelaide (Australia). Div. of Nutritional Biochemistry.

A. W. Pierce.

Aust J Agric Res, Vol 19, No 4, pp 577-587, July 1968. 11 p, 2 fig, 6 tab.

Descriptors: \*Sheep, Saline water, \*Salts, Animal physiology, \*Salt tolerance, Reproduction, Bicar-bonates, Chlorides, Diets, Electrolytes, \*Potable water, \*Groundwater, Water requirements, Weight, Ions.

A study was conducted in Australia in which groups of eight or ten ewes were offered various solutions as drinking waters. In two experiments these comprised: (1) reservoir water (control group); (2) synthetic water containing salts in proportions found in many underground waters in South and Western Australia (chloride water) with a total salt concentration of 1.30%; or (3) synthetic water resembling the waters obtained in Queen-sland from the Great Artesian Basin (bicarbonate water) with a total salt concentration of 0.50%. In a third experiment the total concentration of salts in the chloride water was only 1.00% that of the bicarbonate water again being 0.50%. The intake of saline waters in all experiments was higher than that of reservoir water, the increases ranging from 20 to 50%. No adverse effects were observed on health, food consumption, or wool production of the ewes and lambs as a result of drinking any of the saline waters. (Affleck-Arizona) W69-02756

THE EFFECTS OF SOIL MOISTURE STRESS ON THE GROWTH OF BARLEY: IV. THE RESPONSE TO PRESOWING TREATMENT, Adelaide Univ. (Australia). Waite Inst. For primary bibliographic entry see Field 02G.

For abstract, see . W69-02759

INFLUENCE OF CALCIUM PRETREATMENT WHEAT GERMINATION ON SALINE

Utah State Univ., Logan. Dept. of Botany.
I. I. Chaudhuri, and H. H. Wiebe.
Plant and Soil, Vol 28, No 2, pp 208-216, April 1968. 9 p, 2 fig, 6 tab.

Descriptors: \*Wheat, Saline soils, \*Seeds, \*Germination, Crop response, Absorption, Osmotic pressure, \*Calcium, \*Salt tolerance, Sodium pressure, \*Calcium chloride, Chlorides.

Identifiers: \*Pre-treatment (Plants).

It was found that wheat seeds pretreated with calcium salts induced significant increases in germination on high sodium chloride media. An investigation was conducted to study the characteristics of this salt resistance, and to devise the best pretreatments to induce salt resistance at the germination stage. Germination of water pretreated seeds on 1% NaCl was 8 percent, while pretreatment with 1% CaCl sub 2.2H sub 2 O resulted in 90 percent

germination on 1% NaCl. Pretreatment with sodium and potassium chlorides enhanced germination only slightly. Pretreatment concentrations ranging from 1 to 5% CaCl sub 2.2H sub 2 O, and times ranging from 3 to 24 hours were about equally effective. Pretreatment with calcium resulted in about a 25 percent reduction in Na super 22 uptake from the germination medium. (Affleck-Arizona) W69-02760

EFFECTS OF VERTICALLY HETEROGENOUS SOIL SALINITY ON PLANT GROWTH AND WATER UPTAKE,

California Univ., Riverside. J. Shalhevet, and L. Bernstein.

Soil Sci, Vol 106, No 2, pp 85-93, Aug 1968. 9 p, 5 fig, 2 tab.

Descriptors: \*Saline soils, \*Alfalfa, \*Root systems, Equations, Growth chambers, \*Crop response, Osmosis, Salt tolerance, Irrigation effects, \*Moisture uptake, Absorption, On-site data collections, Soilwater-plant relationships, Root zone, Water utiliza-

By means of a root-compartment technique, the effect of non-uniform distribution of salts in the soil on alfalfa growth and water uptake was studied at Riverside, California. The root system was divided by a horizontal wax membrane into two equal depth sections. Each chamber was salinized and irrigated separately through a wick distribution system. It was found that mean salinity of the root zone was a good estimate o effective salinity and that the salinity of both chambers was equally significant in causing yield reductions. Water uptake from each chamber was strongly influenced by salinity of both chambers. It decreased as salinity of the chamber increased and increased at about half the rate as salinity of the complementary chamber increased. Total plant water potentials were also computed from water-uptake rates and soil-water potentials, using linear-flow equations. (Affleck-Arizona) W69-02761

SOME EFFECTS OF WATER RESTRICTION ON APPARENT DIGESTIBILITY AND WATER EXCRETION OF CATTLE,

Western Australia Univ., Nedlands (Australia). Inst. of Agriculture.

R. F. Thornton, and N. G. Yates.

Aust J Agric Res, Vol 19, No 4, pp 665-672, July 1968. 8 p, 2 fig, 4 tab, 27 ref.

\*Cattle, Animal Descriptors: \*Moisture stress, Water balance, \*Digestion, Feeding rates, \*Urine, Animal metabolism, requirements.

Identifiers: Australia, Dry matter, \*Excretion, \*Water restriction.

An experiment was conducted in Australia to investigate the influence of restricting water intake on dry matter intake, nutrient digestibility, and water excretion of cattle. The interrelationships between these variables and the likely physiological significance of the findings were discussed. During water restriction: (1) Increased dry matter and acid detergent fibre digestibilities could not be wholly accounted for by decreased intake of dry matter. (2) Reduced faecal water output was more important than changes in urine output in conserving water. It was suggested that the hind gut has a regulatory role in the observed responses to water restriction. (Affleck-Arizona) W69-02763

## 2.J. Erosion and Sedimentation

SEDIMENT TRANSPORT IN CONVEYANCE SYSTEMS (PART 2), THE MODES OF SEDI-

## Group 2J - Erosion and Sedimentation

MENT TRANSPORT AND THEIR RELATED BED FORMS IN CONVEYANCE SYSTEMS, Middle East Technical Univ., Ankara (Turkey); and Lehigh Univ., Bethlehem, Pa. Ertan R. Acaroglu, and Walter H. Graf. Bull Int Assoc Sci Hydrol, Vol 13, No 3, pp 123-

135, Sept 1968. 13 p, 4 fig, 1 tab, 13 ref.

Descriptors: \*Sediment transport, \*Conveyance structures, \*Sand waves, \*Suspension, \*Bed load, Reynolds number, Model studies, Regime, Flumes, Prediction, Particle size. Identifiers: \*Bed forms.

Functional relationships between shear intensity and particle Reynolds number are determined using data available from sediment transport model studies. All the data used are plotted. It can be seen from the plot that there are 3 major transport modes. At low flow intensities the major mode is bed load, characterized by ripple and dune move-ment. At higher intensities the bed has a planar shape, more particles are in suspension, but bed load is still dominant. At high intensities the predominant mode of transport is suspension. In free surface flows, the bed form is antidunes, while in closed conduits, a 'sliding bed' is observed. For each of these modes a function relating intensity and Reynolds number is listed. (Knapp-USGS) W69-02501

# A THERMODYNAMIC ANALOGY FOR TRANS-PORT PROCESSES INVOLVING A NON-POSI-TIVE DEFINITE TRANSPORTED QUANTITY,

Illinois Univ., Urbana. C. L. Chung, and A. E. Scheidegger. Bull Int Assoc Sci Hydrol, Vol 13, No 3, pp 88-94, Sept 1968. 7 p, 1 fig, 4 ref.

Descriptors: \*Sediment transport, \*Thermodynamic behavior, Meanders, Mathematical studies, Energy. Identifiers: Transport-thermodynamic analogy.

The sediment transport process may be treated analogously to thermodynamic processes, based on the idea that the transported quantity plays the same role as energy. This works only if transport is a non-negative definite quantity like energy. Some functions, such as momentum, may have non-positive values and are also of interest in transport studies. An extension of the thermodynamic analogy to include analysis of non-positive definite quanti-ties is presented. (Knapp-USGS) W69-02503

## SEDIMENT DISTRIBUTION IN TURBULENT

FLOW, Universidad Central de Venezuela, Caracas.

Konstantin Zagustin. J Hydraul Res, Vol 6, No 2, pp 163-172, 1968. 10 p, 5 fig, 5 ref.

Descriptors: \*Sediment concentration, \*Sediment transport, Sediments, Sedimentation, \*Turbulent flow, Hydraulics, Suspended sediments, Foreign research, Mathematical analysis, Differential equations, Experimental data, \*Sediment distribution,

Hydrology. Identifiers: Prandtl-Von Karman equation, Mixing length, Venezuela.

An analytical expression is derived for determining sediment concentration in turbulent flow. Solution is based upon an expression for kinematic eddy viscosity and coincides with experimental points throughout the whole flow region. The agreement of experimental data with theoretical curves is acceptable, with the value of a parameter z (sediment terminal settling velocity divided by the product of a numerical constant, the Von Karman constant, and the shear velocity) being of lower magnitude and the snear velocity) being or lower magnitude than obtained with previous theories. The method affords improved predictions of sediment distribution. Obtaining the finite value of sediment concentration at the flow surface is of particular interest. Although the shape of the curves is similar to those

previously developed, the difference in magnitude of the parameter z and the concentration at the free surface explain certain phenomena and provide a better framework to present and analyze sediment transport data. (USBR) W69-02564

## THE SEDIMENT YIELD OF MAJOR RIVERS OF THE WORLD, Soil Conservation Service, Hyattsville, Md.

John N. Holeman. Water Resour Res, Vol 4, No 4, pp 737-747, Aug 1968. 11 p, 7 tab, 30 ref.

Descriptors: \*Sediments, \*Sediment yield, \*Rivers, Sedimentation, Soil erosion, Sediment transport, Suspended sediments, Bibliographies, Data collections, Erosion, Hydrology, United States.

Identifiers: \*Worldwide.

The amount of suspended sediment transported by rivers to the seas each year is tabulated. Major rivers are ranked in order of tons of sediment transported per year; drainage area and water discharge data are included. Rivers are listed by continents, in subsequent tables, with data on drainage area, annual sediment yields in tons, sediment production rates in tons per square mile per year, the years of sediment measurement, and sources of data. This sample represents more than one-third of the land contributing waterborne sediment to the seas and, if representative, indicates an annual world sediment yield of 20 billion tons. Data suggest that Africa, Europe, and Australia have very low sediment yields (less than 120 tons per square mile per year), South America's rate is low, North America's is moderate, and Asia's is high to the degree of yielding up to 80% of the sediment reaching the seas annually. (USBR) W69-02568

## A LAG-DEVIATION METHOD FOR ANALYZ-ING CHANNEL BED FORMS, Agricultural Research Service, Oxford, Miss. Sedi-

mentation Lab.

Water Resources Res, Vol 4, No 6, pp 1329-1334, December 1968. 6 p, 3 fig, 1 tab, 9 ref.

Descriptors: \*Alluvial channels, \*Channel morphology, \*Bed load, Dunes, Sand waves, Fourier analysis, Numerical analysis.

A simple method for analyzing alluvial channel bed forms for length and time scales can be applied to records of bed elevation with either distance along the channel or time as moving bed forms pass a channel section. The difficulty of obtaining distance records of bed-form elevation in the field is lessened by the use of simultaneous time records from two closely spaced points along the channel.

Analysis of these dual records provides the dune period and propagation speed from which the dune length may be derived and permits an estimate of the 'dune load,' the average contribution of the moving bed forms to the bed material transport rate. W69-02670

## DEPOSITION OF SUSPENDED PARTICLES IN A GRAVEL BED, California Univ., Berkeley.

H. A. Einstein.

ASCE Proc, J of Hydraul Div, Vol 94, No Hy5, Pap 6102, pp 1197-1205, Sept 1968. 9 p, 2 tab.

Descriptors: \*Suspended load, \*Bed load, \*Deposition (Sediments), Gravels, Settling velocity, Parti-cle size, Silts, Pores, Suspended load, Model stu-

Identifiers: Experimental results, Particle distribu-

A model of silt flowing in suspension over a gravel bed was studied to learn the mechanism of deposi-tion of silt in the interstices of the bed load. Silt was observed to settle through the gravel and fill pore space from the bottom up. The surface remained clean. No horizontal motion of silt relative to the gravel was observed below the gravel bed surface. The probability of deposition is proportional to silt particle availability. The suspension half life is proportional to water depth and inversely proportional to the sile of the sile to the silt settling velocity. Basic data are tabulated. (Knapp-USGS)
W69-02690

## 2K. Chemical Processes

NUTRIENTS LIMITING THE PRODUCTION OF PHYTOPLANKTON IN THE SARGASSO SEA, WITH SPECIAL REFERENCE TO IRON, Bermuda Biological Station, Saint George's West; and Woods Hole Oceanographic Institution, Mass. D. W. Menzel, and J. H. Ryther.
Deep-Sea Res, Vol 7, pp 276-281, 1961. 6 p, 6 tab, 10 ref

Descriptors: \*Nutrients, \*Primary productivity, \*Cycling nutrients, \*Iron, Tropical regions, Phytoplankton, Trace elements, Nitrogen compounds, Phosphorus compounds, Photosynthesis, Limiting Factors, Vitamins, Cobalt, Copper, Manganese, Metals, Molybdenum, Oceanography. Identifiers: Sargasso Sea, Tropical seas, Semi-tropical seas, Bermuda, West Indies, Western Atlantic, Zinc.

Concentrations of nitrate-nitrogen and phosphatephosphorus commonly found in surface waters of phosphorus commonly found in surface waters of the Sargasso Sea theoretically could support popu-lations of phytoplankton 3-10 times greater than those actually found. Authors studied the problem by determining the photosynthetic rate (expressed as uptake of carbon-14 after 4-hr incubation) of resident phytoplankters 24 and 72 hours after enrichment of surface waters with nitrate, phosphate, vitamins, and trace metals (separately or in combination). Addition of trace metals, the active component of which was found to be iron, enhanced photosynthesis several-fold over unenriched con-trols. Nitrate, phosphate, and vitamins, added alone or in combination, had little effect on photosynthesis determined after 24 hours. How-ever, 72 hours after enrichment with tract metals, ever, 72 hours after enrichment with tract metals, nitrate, and phosphate, uptake, relative to unenriched controls, was enhanced by 11.5-16.1 (5 experiments); whereas trace metals alone gave relative uptakes of 1.0-1.3 (3 experiments), and nitrate-phosphate alone gave 0.8-1.5 (5 experiments). With sufficient iron present, naturally occurring concentrations of nitrate and phosphate became limiting after 24-72 hours' incubation. For samples from 12 stations between Bermuda and the West Indies, enrichment with nitrate-phosphate and nitrate-phosphate-iron resulted in relative upand nitrate-phosphate-iron resulted in relative uptakes of 1.4 and 4.4 respectively, indicating that the effect is general for semi-tropical seas. W69-02787

## 2L. Estuaries

PROCEEDINGS SYMPOSIUM ON HYDROLOGY OF THE COASTAL WATERS OF NORTH CAROLINA.

North Carolina Univ., Chapel Hill.

Report No. 5, Water Resources Research Institute of the University of North Carolina, May 12, 1967. 155 pp. OWRR Project A-999-NC.

Descriptors: \*Hydrology, \*Groundwater, \*Estua-ries, Hydrodynamics, Hydrologic data, \*North Carolina, \*Hydrography, Petrology, Mathematical

This Proceedings of a Symposium on Hydrology of the Coastal Waters of North Carolina includes papers related to current research and investigations dealing with ground water and estuarine hydrology in the Coastal Region of North Carolina. Subject matter includes petrology of the Castle

## WATER SUPPLY AUGMENTATION AND CONSERVATION - Field 03

## Conservation in Agriculture—Group 3F

Hayne Formation, salt water encroachment, geophysical techniques, ground water problems of the coastal plain, estuary hydrodynamics, estuary flow patterns, hydrography and hydrology. (Howells-No Carolina) W69-02487

DELTA-SUISUN BAY WATER QUALITY AND HYDRAULIC STUDY,

San Francisco Bay District, Vallejo, Calif. Dept. of Water Resources.

water Resources. Charles A. McCullough, and Jerry D. Vayder. ASCE Proc, J Sanit Eng Div, Vol 94, No SA 5, Pap 6143, pp 809-827, Oct 1968. 19 p, 6 fig, 5 tab, 2

Descriptors: \*Water quality, \*Estuaries, \*California, \*Saline water intrusion, \*Mathematical models, Farm wastes, Water pollution sources, Tracers, Model studies, Laboratory tests, Digital computers, Computer models, Biochemical oxygen demand.

Identifiers: San Francisco Bay, Suisun Bay.

Present water quality throughout the Sacramento-San Joaquin Delta and Suisun Bay in California was determined. Sources and amounts of wastes which could cause water-quality degradation were examined to evaluate present and future effects on receiving waters. Findings showed degradation of water quality to be caused by natural and manmade processes, including the life cycles of aquatic organisms, land-surface runoff, sediment transport by high water flows, biochemical cycles, and highly mineralized surface or ground waters. Fluorescent dye-tracer studies were conducted, using the prototype and a hydraulic model to investigate travel and residence time, flow distribution and circulation patterns, mixing and dispersion characteristics and to estimate changes in constituent concentrations resulting from future discharge of municipal, industrial, and agricultural wastes. A mathematical model was used to simulate the hydraulic characteristics of the Delta, the solution of the model program by digital computer provided the hydraulic parameters for anticipated future flow conditions. Control of water quality by low flow augmentation to prevent deep saline intrusion and to dilute streamflow is recommended. (Knapp-USGS) W69-02493

OXYGEN DEMAND AND OXYGEN DEPLE-TION CAPACITY OF SEDIMENTS FROM WAS-SAW SOUND, GEORGIA,

Georgia Univ., Athens.
For primary bibliographic entry see Field 05C. For abstract, see . W69-02673

## 03. WATER SUPPLY **AUGMENTATION** AND CONSERVATION

#### 3A. Saline Water Conversion

CORROSION OF METALS IN DESALINATION

ENVIRONMENTS,
Dow Chemical Co., Freeport, Tex.; and Office of
Saline Water, Washington, D. C.

For primary bibliographic entry see Field 08G. For abstract, see . W69-02582

TRANSPORT OF ELECTROLYTES THROUGH

MEMBRANE SYSTEMS, Southern Research Inst., Birmingham, Ala. For primary bibliographic entry see Field 05F. For abstract, see . W69-02783

THERMOSPHYSICAL **PROPERTIES** 

SALINE WATER, Monsanto Research Corp. Everett, Mass.

For primary bibliographic entry see Field 01B. For abstract, see . W69-02784

VAPOR PRESSURE LOWERING OF AQUEOUS SOLUTIONS AT ELEVATED TEMPERATURES, Westinghouse Research Labs., Pittsburgh, Pa.

For primary bibliographic entry see Field 01B. For abstract, see. W69-02785

## 3B. Water Yield Improvement

WATER HARVESTING LIVESTOCK OR HOME, WATER PLAN

Arizona Univ., Tucson. Coll. of Agriculture. C. Brent Cluff.

Progressive Agriculture, College of Agriculture, University of Arizona, Vol. XIX, No. 3, pp 6-8. OWRR Project A-001-Ariz.

Descriptors: Watershed management, Water yield, Water storage.

Treated catchments have been used since Biblical times for obtaining water supplies. The chief limita-tion on this technique has been the high cost per unit of water produced. With advances in modern technology, costs of treatment have been greatly reduced. Use of chemically inert plastic holds considerable promise both in treatment of catchment areas and sealing of storage tanks. An one half-acre gravel-covered plastic catchment was established g a newly developed plastic-laying gravel ader. Runoff from the catchment flows into an 100,000 gal. storage tank lined with plastic and covered with butyl rubber. The installation and materials costs of both catchment and tank is estimaterials costs of both catchinent and tank is estimated at 2,300. It is expected that the system will last at least 15 years, and provide a firm supply of 100,000 gal. of high quality water per year in an 11-inch rainfall zone. (Resnick-Ariz) W69-02483

EFFECTS OF CULTURAL CHANGES ON MAKARA EXPERIMENTAL BASIN, Ministry of Works, Wellington (New Zealand). Water and Soil Div. C. Toebes, F. Scarf, and M. E. Yates. Bull Int Assoc Sci Hydrol, Vol 13, No 3, pp 95-122, Sept 1968. 28 p, 17 fig, 3 tab, 17 ref.

Descriptors: \*Small watersheds, \*Agricultural watersheds, \*Cultural control, \*Overland flow, \*Infiltration, Soil management, Hydrographs, Peak discharge, Duration curves, Grazing. Identifiers: \*Hydrological processes, New Zealand, Oversowing, Topdressing.

The effects of oversowing and topdressing unimproved pastures on small catchments of a few acres each is discussed. Analyses are intended to determine hydrological tendencies and are of a prelimimary nature only. The land management change in-dicated has, together with a trebling of the produc-tion, had a considerable hydrological effect. There has been some decrease in annual run-off, a probably increase in infiltration, an increase in surface detention, a reduction in the number of days on which flow occurred and a reasonably uniform decrease in the percentage occurrence of given daily run-offs over the greater part of the flow range. Individual hydrographs have shown no decrease in rise time, but an increase in depletion time, decreased peak discharges and decreased run-off. W69-02502

MANIPULATION OF WATER USE IN AN ASPEN FOREST,

Utah State Univ., Logan; and Utah Center for Water Resources Research, Logan.
John D. Schultz, George B. Coltharp, George E.

Hart, and Michael Zan.

Proceedings of the Third Annual American Water Resources Conference, 1967, pp 149-159. 11 p, 3 fig, 1 tab, 13 ref.

Descriptors: \*Water utilization, Evapotranspira-tion, \*Water supply, Vegetation, Hydrologic budget, Utah, Soil moisture. Identifiers: Aspen, \*Vegetation manipulation.

Our society is continually searching for new sources of water to exploit. Manipulating wild land vegetation to augment water supplies is a field of consideration which embodies two considerations-tapping new water supplies and making more efficient use of existing supplies. It is often stated that some types of wild vegetation use more water than is actually required to keep them alive. Whether or not such claims are correct, it is true that some forest trees grow on sites and in climates where their water supply is not as great as it is in other places. Thus, the idea of manipulating wild land vegetation to decrease water use has been popular for some time. A growing body evidence indicates that definite increments to water supplies may be obtained when watershed vegetation receives cer-tain treatments. The authors' data for the growing seasons of 1966 and 1967 indicate that significant seasons of 1900 and 1907 indicate that significant changes in the water use budget in an aspen forest can be accomplished by vegetative manipulation. The possibilities of success are greater in areas where greater amounts of precipitation are encountered, but it is apparent that these are tools of watershed management in water-scarce areas where even a slight increase in water yield is important. (Seneca-Rutgers) W69-02541

#### IATT LAKE WATER CONSERVATION DIS-TRICT.

LA Const Art 15, Para 4 (1956).

Descriptors: \*Louisiana, Legislation, \*Water district, \*Conservation, Fresh water, \*Water supply, Lakes, Streams, Pollution, Ditches, Channels, Dams, Levees, Administrative agencies, Eminent domain, Local governments. Identifiers: latt Lake.

This section creates the latt Lake Water Conservation District. The purposes of the District are: (1) to make available an adequate fresh water supply for industrial and other consumption; (2) to preserve the waters of the District; (3) to prevent pollution and blocking of streams; (4) to prevent contamination; (5) to acquire and operate facilities in the District; (6) to prevent the escape of any such waters until employed to the maximum benefit. The Board of Commissioners of the District; (6) to prevent the context of the District; (6) to prevent the context of the District of the Distric trict is granted powers necessary to accomplish the District's purposes. Among the powers specifically enumerated in this section is the power to incur non-funded debt. (Childs-Fla) W69-02731

#### 3F. Conservation in Agriculture

ADVANCED PIPELINE TECHNOLOGY FOR IRRIGATION PROJECTS,
United Technology Center, Sunnyvale, Calif.
For primary bibliographic entry see Field 08A. For abstract, see . W69-02559

## MANAGEMENT: A KEY TO IRRIGATION EF-

FICIENCY, Leonard J. Erie.

Proc Amer Soc Civ Eng, J Irrig Drain Div, Vol 94, No IR3, pp 285-293, Sept 1968. 9 p, 2 fig. 4 tab, 10 ref, append.

Descriptors: \*Irrigation efficiency, \*Efficiencies, \*Irrigation, \*Water management (Applied), Water conservation, Crops, Sugar beets, Irrigation systems, Sprinkler irrigation, Consumptive use, Fruit crops, Sorghum, Water utilization. Identifiers: Grapes.

Irrigated agriculture accounts for 80-90% of all water consumptively used in the United States. Nearly 42% of the water delivered to irrigated

## Field 03 - WATER SUPPLY AUGMENTATION AND CONSERVATION

## Group 3F-Conservation in Agriculture

farms is not used beneficially by plants. Part of this water is waste that could be avoided by proper management. Inefficient water application can be minimized if the questions of when, how, how much, and why water is applied are answered.

Many western states have results of studies indicating the optimum times to irrigate. When such information is not available, consumptive use estimates, coupled with knowledge of soils and root systems, provide a good basis for scheduling irrigations. Recent trends in most efficient irrigation systems are toward sprinkler, dead-level, and pump-back irrigation systems. Periodic releveling of soil on existing systems improves the efficiency and distribution of irrigation water. Labor problems, water shortages, and increased costs of all farm operations have necessitated improving irrigation systems. All communities have different problems and their approach to water conservation will be equally different. However, education, research, and technical assistance to the individual irrigation farmer must be used to obtain the greatest benefit from our limited water resources. (USBR) W69-02567

#### OPTIMUM IRRIGATED PRACTICE UNDER CONDITIONS OF DEFICIENT WATER

SUPPLY, California Univ., Los Angeles. For primary bibliographic entry see Field 06A. For abstract, see . W69-02610

## EFFECT OF ANTITRANSPIRANT TREATMENT ON LEAF TEMPERATURES,

Hebrew Univ., Jerusalem (Israel). Dept. of Botany. J. Gale, and A. Poljakoff-Mayber. Plant Cell Physiol, Vol 6, No 1, pp 111-115, March 1965. 5 p, 2 fig.

Descriptors: \*Transpiration control, \*Air temperature, Wind velocity, \*Leaves, Transpiration, Thermal stress, Heat balance, Emulsions, \*Inhibitors, Temperature, Cooling, Fluctuation.

Identifiers: \*Leaf temperature, Thermistor probe,

Thermocouple.

Three different antitranspirants, all of the plastic emulsion type, were tested. Leaf temperatures were determined in the field by a thermistor probe and in the laboratory by a rapidly equilibrating thermocouple contact probe. The antitranspirants were: Tag-a polyethylene based emulsion, a copolymer dispersion of acetate acrylate esters and a copolyacrylic emulsion. All three antitranspirants were found to be not toxic to any of the plants in the experiments. Despite wide fluctuations of air temperature and moderate wind conditions in the field, leaf temperatures were at all times plus or minus 2 degrees C of the ambient air temperature. There was no consistent difference between the leaf temperatures of control and antitranspiranttreated plants. Use of copolymer dispersion of acetate acrylate esters on bean plants caused transpiration to be reduced by 36%. Under field conditions, transpiration was only a minor factor in cooling plant leaves. It is most unlikely that antitranspirants could raise plant leaf temperatures to thermal death point in arid climates. (Blecker-Arizona) W69-02767

## 04. WATER QUANTITY **MANAGEMENT AND** CONTROL

## 4A. Control of Water on THE Surface

DRAINAGE BY COUNTIES. For primary bibliographic entry see Field 06E. For abstract, see . W69-02412

LABBADIN V BAILEY (WATER LEVEL). For primary bibliographic entry see Field 06E. For abstract, see.

## NEKOOSA-EDWARDS PAPER CO V PUBLIC SERVICE COMM'N (PERMITS FOR DIVERSION OF NAVIGABLE WATERS).

8 Wis 2d 582, 99 NW 2d 821-828 (1959).

Descriptors: Flow, Streamflow, \*Alteration of flow, Navigable waters, \*Administrative agencies, \*Wisconsin, Legislation, Diversion, Water management (Applied), \*Water permits, Permits, Riparian rights, Administrative decisions, Agriculture, Irrigation, Judicial decisions.

Riparian owners petitioned the court to set aside an order of the commission granting permits for the diversion of nonsurplus water from a navigable stream. Wisconsin statutes, sec 31.14, provides for the commission to issue permits for the diversion of surplus water from navigable streams for the purpose of maintaining the normal level of any naviga-ble lake or the normal flow of water of any navigable stream. Permits for the diversion of nonsurplus water shall be issued only with the consent of riparian owners damaged thereby and for the purpose of agriculture or irrigation. In this case petitioners did not consent to nonsurplus water being diverted for this purpose, but the commission issued permits upon a finding that these riparian owners would not be damaged thereby. The Wisconsin Supreme Court held that this statute did not confer authority upon the commission to make such a finding. Once the commission determined this to be nonsurplus water it was powerless to issue the permits without the consent of the petitioners. Jurisdiction still rests with the courts to determine common-law rights of riparian owners with regard to nonsurplus waters in navigable streams. (Mc-Dermott-Fla) W69-02430

## HENRY V BAHNS (DRAINS). 165 NE 2d 686 (Ohio Ct App 1959).

Descriptors: Water law, Subsurface drains, \*Closed conduits, Stress, Water pressure, Flow resistance, \*Ohio, Judicial decisions.

Plaintiff farmers sought to prevent county from til-ing and straightening a drainage ditch inasmuch as the engineering plans for the work did not provide for sufficiently large tiles to carry the expected volume of water. The basic issue involved was the adequacy of the size of the tile proposed to be used by the county in constructing the improvements. The size of the proposed tiles had been reached by applying a mistaken theory since tiles of the same size had previously failed in the same ditch for unknown reasons. The decision of the trial court, upholding the plan adopted by the county commissioners, was reversed and the case remanded for further proceedings according to law. (Dann-Fla) W69-02431

#### KREBS V VIGOR (LATERAL DRAINAGE). 164 NE 2d 811-812 (1958).

Descriptors: \*Surface drainage, Laterals, Waste water, Water law, Surface runoff, \*Ohio, Judicial

Plaintiff sought to temporarily restrain the board of education from constructing lateral ditches which education from constructing lateral ditches which would drain waste water into an existing drainage ditch which crossed plaintiff's land. Plaintiff alleged that the existing ditch was too small for its present flow and was overburdened by the flow from several presently existing lateral ditches. In denying the relief sought, the court noted that the plaintiff might well have a cause sufficient to merit permanent relief, but felt that plaintiff had not sufficiently proved his case, especially in light of the ficiently proved his case, especially in light of the fact that to grant the relief sought would hamstring the construction of a new school. (Dann-Fla)

W69-02432

#### MALLARD V PYE (DRAINAGE). 215 Ga 645, 112 S E 2d 620-621 (1960).

Descriptors: Surface drainage, Surface runoff, Flow around objects, \*Natural flow, \*Obstruction to flow, \*Surface waters, Watercourses, Natural flow, Doctrine, Overland flow, Water rights, \*Judicial decisions, Ditches.

This is an action grounded in equitable estoppel brought by a higher owner against a lower owner to enjoin the lower owner from constructing and maintaining obstacles on her property which interfered with the natural flow and drainage of surface waters across petitioner's property. The court granted the injunction holding that a lower proper-ty owner owes a servitude to a higher owner so as to create a duty to receive normal surface flowage, provided the higher owner has done no act to increase such flow by artificial means. (Carruthers-Fla) W69-02433

## MACKEY V LUBIN (ARTIFICIAL BARRIERS). 9 Chest 193-200 (Pa Com P1 1959).

Descriptors: Judicial decisions, Legal aspects, Artificial watercourses, Barriers, Flooding, \*Reasonable use, \*Negligent inundation, Diversion structures, \*Pennsylvania, Surface waters, Surface drainage, Natural flow, Obstruction to flow, \*Surface runoff.

Identifiers: Artificial barriers.

In the process of developing his land for residential purposes, defendant opened a road and slightly graded an adjoining road bringing about a small in-crease in the soil content of the surface water which naturally drained onto plaintiffs' adjoining land. Defendant also caused dirt fill to be piled in such a way as to constitute a barrier to the natural flow of surface water. Normal hard rains caused a break in the barrier, and, because of its concentra-tion, the water deviated from its natural channel over the plaintiffs' land, damaging a row of pine trees. The plaintiffs could not recover for the increase in soil content of the water draining into their land because an upper landowner may make proper and profitable use of his land even though such use may result in some change in quality or quantity of the water flowing to lower land. How-ever, the plaintiffs recovered for the damage to their pine trees caused by the break in the barrier. An upper landowner may not negligently cause unnecessary damage to a servient owner nor erect an artificial barrier to collect and discharge surface waters in greatly increased quantities upon his neighbor's property. (Molica-Fla) W69-02438

## JACOBS V FRANGOS (DIVERSION OF SURFACE WATER).

329 SW 2d 262-264 (Ct App Mo 2959).

Descriptors: Watercourses (Legal), Legal aspects, Judicial decisions, \*Alteration of flow, \*Ditches, Trenches, \*Missouri, Soil erosion, Water injury, Natural flow, \*Flood damage, Streamflow, Floods, Obstruction to flow, Stream beds, Diversion.

Defendants excavated a ditch in a creek bed which changed the natural course of the stream. Plaintiffs, adjoining landowners, brought suit to recover for flood and erosion damage to their property which thereafter resulted during periods of high water in the creek. Defendants contended that the trail court erred in giving a jury instruction as to the change of the natural water course of the creek since no evidence was introduced on this issue. The court held that the basis of plaintiffs' claim was not that an entirely new watercourse had been created by the defendants, but that through their excavation they diverted the water from its natural course onto the land of the plaintiffs causing damage. One

may not obstruct or so divert the natural flow of a stream without liability for ensuing damage to others. (Molica-Fla) W69-02439

OELKE V COUNTY OF FARIBAULT (FINDINGS NECESSARY TO OVERTURN DRAINAGE ORDER).

110 NW 2d 145-150 (Minn 1961).

Descriptors: \*Minnesota, Judicial decisions, \*Drainage programs, Drainage, Ditches, Drainage water, Public health, Local governments, \*Estimated benefits, Estimated costs, Assessments. Identifiers: Police power.

This was an appeal from a board of county commissioner's order which established a ditch to improve the existing drainage system. To overthrow such an order, under Minnesota statute, it must be shown that the total estimated cost of the project, including damages, is greater than the estimated benefits or that the order appealed from is unlawful and unreasonable. The court held that neither of these criteria were met by the appellant. The court further held that even if there was evidence that assessments as to particular tracts of land were erroneous, this was not sufficient to vitiate the entire order. (Sisserson-Fla) W69-02440

## MORRIS V CUMMINGS (INCREASED SUR-FACE WATER FLOW DAMAGING LOWER

116 SE 2d 592-594 (Ga 1960).

Descriptors: \*Surface water, Drainage ditch, Water flow, \*Water control, \*Drainage systems, Rain water, \*Surface runoff, Standing waters, \*Drainage effects, \*Controlled drainage, Natural flow, Regulated flow, Culverts, Judicial decisions. Identifiers: Debris.

Petitioner claimed that defendants had created a nuisance by artificially increasing the natural flow of surface water from their property onto that of the petitioner and requested that the defendants be enjoined from continued operation of this alleged nuisance. Defendants had dug a drainage ditch across their property to carry off the surface water. The ditch emptied into the street causing damage to the street and to the plaintiff's property on the other side. There had once been an agricultural ditch across the property, but it had been in a dif-ferent place and had been filled in many years before. The court said that, 'as to surface water, one land proprietor has no right to concentrate and collect it, and thus cause it to be discharged upon the land of a lower proprietor in great quantities at a particular locality, or in a manner different from that in which the water would be received by the lower estate if it simply ran down upon it from the upper by the law of gravitation.' The injunction was granted. (Rief-Fla)
W69-02455

## HOOD V SLEFKIN (SUIT TO ENJOIN DAM OWNER FROM CHANGING WATER LEVEL).

143 A 2d 683-689 (RI 1958).

Descriptors: \*Rhode Island, Judicial decisions, \*Riparian rights, \*Dams, Reservoirs, Streamflow, Natural flow, Alteration of flow, Lakes, \*Water levels, Water level fluctuations, Bodies of water, Impoundments, Impounded waters, Sewage sludge, Diversion.

Identifiers: Artificial lakes.

Suit was brought by several landowners whose land abutted a pond created by the respondents' dam. Landowners on the stream below the dam also brought suit. The owners on the pond complained that the dam owners had permanently lowered the level of the pond, exposing sludge deposited by a sewage disposal plant. The owners below the dam complained that the flow of the stream had been substantially increased. On appeal the Rhode Island Supreme Court held that even though respondent dam owners had gained a prescriptive right to overflow the lands of complaints above the dam, there was no reciprocal right in the landowners to have the pond maintained at the same level. This holding applied also to the owners below the dam, who sought to compel the respondent to continue to maintain the dam in the same manner. The owners of land abutting the pond contended that exposure of the sludge created a nuisance because of the foul odor emitted. The court said that an essential element of a nuisance is that the person to be charged with liability must have an element of control over the condition. In this case, the muck was deposited by a sewage disposal plant which was beyond control of respondent. The court said that riparian owners below a dam have a right to the natural flow of the stream without diversion, but in this case the landowners below the dam had not overcome the burden of proof that they were riparian owners. (Williams-Fla) W69-02465

#### SEEPAGE UNDER SHEET PILES.

Birmingham Univ. (England). R. Herbert.

Civ Eng, Vol 63, No 746, pp 977-980, Sept 1968. 3 p, 5 fig, 3 tab, 5 ref.

Descriptors: \*Seepage, \*Sheet piling, \*Electric analogs, \*Groundwater flow, Electrical networks, Flow nets, Ground water, Head losses, Darcys Law, Discharges, Aquifers, Resistors, Hydraulic gradients, Foreign research, Simulation. Identifiers: Great Britain, Accuracy.

An accurate new method is described for representing seepage under sheet piles by adapting the normal resistor network technique for seepage systems to simulate singularities. Singularities occur in seepage systems when any flowline turns through a sharp angle such as at the base of sheet piles. Large head losses occur at these points, and if they are ignored when obtaining a solution to a sheet pile system, gross errors in discharge esti-mates can occur. Accuracy (discharge to 1%) of the technique, when simulating flow under sheet piles, is demonstrated by the analytical solution of or simplified sheet pile systems. Complex seepage problems, including multilayered aquifers with more than one sheet pile penetrating to varying depths, can be simulated. The technique uses a resistor network to solve the finite difference form of the ground-water flow equation, but is easily adaptable to all finite difference-based solutions and, in particular, is suitable for use in the wellestablished relaxation technique for seepage solution. (USBR) W69-02574

## AIRPHOTO INTERPRETATION AS AN AID IN FLOOD SUSCEPTIBILITY DETERMINATION, Department of Energy, Mines and Resources,

For primary bibliographic entry see Field 07B. For abstract, see . W69-02597

## ANALYTICAL SIMULATION,

Oregon State Univ., Corvallis. For primary bibliographic entry see Field 06A. For abstract, see . W69-02605

## LINEAR DYNAMIC DECOMPOSITION PRO-GRAMMING OF OPTIMAL LONG RANGE OPERATION OF A MULTIPLE MULTI-PUR-POSE RESERVOIR SYSTEM,

California Univ., Berkeley. For primary bibliographic entry see Field 06B. For abstract, see . W69-02617

#### PROJECT YIELDS BY A PROBABILITY METHOD,

Colorado River Board of California, Los Angeles. For primary bibliographic entry see Field 06A. For abstract, see . W69-02623

#### **CHAPTER 5: NATURAL WATERCOURSES.**

Illinois Univ., Urbana; and Economic Research Service, Washington, D. C. For primary bibliographic entry see Field 06E. For abstract, see. W69-02626

## CHAPTERS 6-10: PERCOLATING GROUND-WATER; SUBTERRANEAN WATERCOURSES: SPRINGS; SURFACE WATER; DRAINAGE,

Illinois Univ., Urbana; and Economic Research Service, Washington, D. C. For primary bibliographic entry see Field 06E.

For abstract, see. W69-02627

## HAFERKAMP V CITY OF ROCK HILL (ACTION FOR DAMAGES FROM COLLECTION AND DISCHARGE OF SURFACE WATERS).

316 S W 2d 620-630 (M 1958).

Descriptors: \*Missouri, Judicial decisions, Damages, Cities, Drainage, Pipes, Surface runoff, Surface waters, Channels, Ditches, \*Storm drains, Discharge (Water), \*Repulsion (Legal aspects), Sinks, Natural flow doctrine, \*Alteration of flow, Roads, Watersheds (Basins), Water law.

Property owners brought this action for damages caused by the alleged unlawful collection and discharge of surface waters upon the plaintiffs' property by the developers of a subdivision. The plaintiffs won in the trial court, but the Supreme Court of Missouri reversed and remanded. The Supreme Court held that where the subdivision developers had artificially collected waters into a concrete pipe which ended at a natural drainage channel leading to a sinkhole on the plaintiffs property, there was no violation of the property owners' rights because the surface waters would naturally flow to the sinkhole regardless of how they were collected. Missouri, with modifications, adheres to the 'common enemy doctrine'. Stated in its extreme form, each landowner has the unqualified right to fend off surface waters as he sees fit without being required to take into account the consequences to other landowners, who have the duty and right to protect themselves as best they can. This right to fend off surface waters is preserved even though in doing so one might increase and accelerate the flow of surface waters, causing damage to other land. (Watson-Fla) W69-02636

## PRICE V DICKSON (HOMEOWNERS ACTION AGAINST SUBDIVISION DEVELOPERS FOR DAMAGES FROM FLOODING OF BASE-MENT). 317 S W 2d 156-158 (Ky Ct App 1958).

Descriptors: \*Kentucky, Judicial decisions, \*Damages, \*Flooding, Surface runoff, Drainage, Ditches, Storm runoff, Subsurface runoff, \*Storm drains, Sewers, Manholes. Identifiers: Negligence.

Homeowners brought an action against subdivision developers for damages to their residence resulting from a flooding of their basement. The homeowners won in trial court. The Court of Appeals of Kentucky affirmed the decision, holding that the acts of the subdivision developers in filling up a ditch into which storm sewers constructed under the homeowners' lot naturally drained created, or substantially contributed to, the flood-ing condition. The subdivision developers were negligent in failing to provide adequate drainage from the ditch they had altered for their purposes.

## Field 04—WATER QUANTITY MANAGEMENT AND CONTROL

## Group 4A—Control of Water on the Surface

The trial judge's instructions to the jury authorized them to award the plaintiffs such sums as will reasonably compensate them for diminution in the value and use of the property. The court stated that the cost of reasonably necessary repairs, as well as the discomfort caused by the injury, are factors to be considered under this standard instruction when the injury is one of a temporary nature. (Watson-Fla) W69-02638

THORSON V BOARD OF SUPERVISORS OF HUMBOLDT COUNTY (SUBSTANTIAL COMPLIANCE WITH DRAINAGE PLAN).

90 N W 2d 730-737 (Iowa 1958).

Descriptors: \*Iowa, \*Drainage districts, Judicial decisions, Local governments, \*Bank erosion, Canal embankments, Channel erosion, Slopes, Banks, Channels, Drainage, \*Drainage engineering, Ditches, Drainage programs, Drains, Tile drains, Excavation, Canal construction, Legislation

Plaintiff, a landowner, objected to the county engineer's certificate that work upon a drainage improvement district had been completed in accordance with plans and specifications. His basic objection was that the excavation of the drainage channel, particularly on its south bank, is rough and uneven; and that it does not conform to the slope required but is vertical, resulting in caving in of earth to obstruct the flow of water in the ditch and to undermine the roadway of the adjoining public highway. An expert testified that in his opinion further excavation would only increase slipping of the banks and likelihood of damage to the highway because of the unusual character of layers of clay soil found there; and that the work as done furnished adequate drainage for the district, including an outlet for plaintiff's tile. The court held that defendant's failure to direct the engineer to make a report showing changes or modifications of the plan necessary to meet changed conditions did not prevent it from accepting the work, because statutes concerning drainage districts should be liberally construed. An informal consultation between the defendants and the engineers was held to be sufficient compliance with the statute requiring a report showing such changes or modifications of the plan as might be necessary to meet the change of conditions. (Scott-Fla)

#### FLOOD CONTROL AND RELATED MATTERS. La Rev Stat secs 38:81-83 (1965).

Descriptors: \*Louisiana, United States, Legislation, \*Flood control, Administrative agencies, Navigation, Rivers, Land reclamation, Reforestation, Land development, \*State governments, Water resources development.

Identifiers: Federal Flood Control Act.

The governor is authorized to enter into contracts with federal authorities with respect to the control of flood waters, navigation of rivers flowing through the state, land reclamation, and related matters. The governor is authorized to accept lands from the United States as provided by the flood control act. The governor may perform any act necessary to obtain relief provided for by the flood control act. (Childs-Fla) W69-02645

BRISTOL COUNTY WATER CO V OLIVIERA (EMINENT DOMAIN FOR PROTECTION OF A RESERVOIR).

141 A 2d 443-447 (R 1 1958).

Descriptors: \*Rhode Island, \*Eminent domain, Judicial decisions, \*Reservoirs, Water storage, Saline water, Water pollution, Water supply, Dams, \*Dikes, Administrative agencies, Condemnation.

Bristol County Water Company proceedings to condemn land in order to erect a dike to prevent the inundation of its reservoir by sea water. The owners of such land objected to it being condemned, and excepted from the lower court's finding that the taking was necessary. The exceptions were based primarily on the lan-downer's contention that the company's condemnation was improper. The court held that it was proper, and that the proposed dike was not a 'dam, the specifications of which were required to be submitted to an administrative officer. It also held that where the company had already built a reservoir, a dike to prevent its inundation by salt water did not substantially alter its character, which would have required the submission of specifications to the Chief of the Division of Harbors and Rivers. Finally, the court held that the record showed the trial judge was not clearly wrong in his determination of the public necessity of the taking. The case was remitted to the trial court for further proceedings. (Williams-Fla) W69-02650

MCHUGO V KOZAK (INTERFERENCE WITH NATURAL FLOW OF A STREAM). 188 NYS 2d 253-256 (N Y Sup Ct 1958).

Descriptors: \*New York, Judicial decisions, Legislation, \*Obstruction to flow, \*Diversion, Stream flow, Natural flow, Damages, Erosion, Flood damage, Dams, \*Natural streams.

Upper landowners sought an injunction pendente lite to restrain lower landowners from interfering with the alleged natural channel of a stream. Allegedly an obstruction placed across the stream caused the stream to follow a new channel, dug by defendants, to an abandoned mill race. This interference with the natural flow of the stream caused the water to back up, doing damage to plaintiff's lands. Defendants interference with the natural flow by diverting a portion of the flow over a different portion of their own land. The court found the evidence insufficient to show any damage. A temporary injunction will only be granted where irreparable injury is threatened and where the right is established with undisputed clearness. The granting of the injunction is also discretionary. (Childs-Fla) W69-02654

#### MILLS, DAMS AND RESERVOIRS. Mass Ann Laws ch 253 secs 1-62 (1967).

Descriptors: \*Massachusetts, Legislation, \*Reservoirs, \*Mills, \*Mill dams, Water law, Legal aspects, Impounded waters, Water damage, \*Operation and maintenance, Dam construction, Dam design.

A person may, subject to this chapter, erect a mill and dam in any non-navigable stream in order to raise water for work purposes. A dam may not be erected to the injury of a lawfully existing mill. Provision is made for recovery of damages by persons whose land is injured by the overflow caused by dams. An enforceable lien is placed on the mill, dam, and land of the violator as of the date a petition is filed against him. The statute states that the inclusion of this remedy is to preclude the use of common law remedies for the recovery of damages caused by dam construction and maintenance. Other provisions cover collection and payment of damages and filing of new petitions. Secs 39-41 concern dams to flood land for cultivation of cranberries and to form ice ponds. Secs 42 and 43 concern dams of reservoir corporations. Safety and inspection procedures for the construction and maintenance of dams and reservoirs are set out in Secs 44 through 50. Secs 51 through 62 concern required repairs and rebuilding of mills and mill dams. (Williams-Fla) W69-02657

WERLING V NEW HAVEN CONSERVATION CLUB (INJUNCTION TO REMOVE DAM).
154 N E 2d 124-125 (Ind Ct App 1958).

Descriptors: \*Indiana, Judicial decisions, Conservation, \*Dams, Flow, Channels, Natural flow doctrine, \*Flooding, Rainfall, Drainage, \*Tile drains, Silts, Rivers, Obstruction to flow, Surface drainage, Surface runoff.
Identifiers: Injunction, Gulleys.

Plaintiff sought a mandatory injunction to compel defendant to remove a dam and to refrain from interfering with the flow of water along a natural watercourse. The trial court denied the injunction, and the Appelate Court of Indiana affirmed. The appelate court held that the evidence justified the finding that defendant's dam had nothing to do with flooding the plaintiff's lands. The plaintiff's land drained through a line of tile into a gulley. The defendant built a dam across the gulley. evidence indicated that the overflow of plaintiff's land was due to the fact that the line of tile was broken down in places and filled with silt and debris. The flooded condition of the plaintiff's land was due to the failure of such defective tile to carry over normal rainfall and not to the back-up of water in the tile caused by plaintiff's dam. (Watson-W69-02715

NAVIGATION AND SHIPPING; CANALS AND OTHER WATER COURSES.

La R S'34:341-346; 34:361 (1965).

Descriptors: \*Louisiana, Local governments, Public benefits, Right-of-way, State governments, \*Locks, \*Canals, \*Navigation, Inland waterways, Levees, Mississippi River, Ownership of beds, Legislation, Eminent domain, Condemnation.

The Commissioner of Wild Life and Fisheries is authorized to acquire any systems of locks and canals in the coastal parishes of the State which are useful to vessels engaged in the sea food industries of the state. He is also authorized to operate said canals and locks. Canals and locks may be acquired by purchase, lease, or eminent domain proceedings. The purpose of the law is to provide free navigation and lockage in the systems so as to foster and develop the sea food industry of the State. When these facilities form a part of a levee system, including the navigation locks and facilities in the Mississippi River, they shall be maintained and operated by the Department of Public Works. Owners or person in charge of locks may not charge more than a maximum statutory fee for any vessel owned by the State. Any domestic corporation established for the purpose of cutting canals in the state shall have a right of way through any state-owned land for the canal and the use of the banks thereof for depositing the excavated dirt. (Scott-W69-02724

PROPERTY OWNERS. La R S 33:5060-61 (1965).

Descriptors: \*Louisiana, \*Local governments, Drains, Sewers, Conduits, Culverts, Inspection, Cities, Construction, Dam construction, Legislation.

All owners of real property must receive the approval of the municipal authorities before constructing any artificial drain, storm sewer, conduit, or culvert across private property. The municipal government may inspect all work to see that it complies with the specifications and plans it previously approved. All municipalities may adopt ordinances necessary to carry out the above and may provide penalties for any violations. (Scott-Fla) W69-02725

CITY OF LAKE CHARLES RECLAMATION AND DEVELOPMENT OF LAKE BED AND WATERFRONT. La Const Art 14, sec 47 (1966).

## WATER QUANTITY MANAGEMENT AND CONTROL-Field 04

## Groundwater Management—Group 4B

Descriptors: \*Louisiana, Legislatión, Local governments, Cities, \*Land reclamation, \*Lake beds, Embankments, Breakwaters, Sea walls, Jetties, Beaches, \*Financing.
Identifiers: \*Mineral rights.

This section grants to the city of Lake Charles the power to construct and maintain embankments, seawalls, jetties, breakwaters, waterbasins and other works as well as public parks, plazas, beaches, and related developments. All mineral rights are reserved to the state. The City of Lake Charles is also empowered to issue additional bonds to finance these projects. (Childs-Fla)

#### SABINE RIVER AUTHORITY.

La Const Art 14, sec 45 (1960).

Descriptors: \*Louisiana, Legislation, \*Administrative agencies, \*Navigation, Drainage, \*Flood control, Irrigation, Water supply, Hydroelectric power, United States, Texas, Dams, Locks, Canals, Hydroelectric plants, Watershed management. Identifiers: Sabine River, Calcasien River.

The Sabine River Authority is an agency of the state. The purposes of the Authority are: (1) to improve navigation on the Sabine River; (2) to provide adequate drainage and flood control within the Sabine River and Calcasien River watersheds; (3) to utilize the Sabine River for recreation and navigation; (4) to maintain an adequate water supply; and (5) to develop hydroelectric power. The governing body of the Authority is given broad powers of control and management to accomplish the Authority's purposes. (Childs-Fla) W69-02734

#### DRIVE-IN REALTY CORP LEWIS (DISCHARGE OF SURFACE WATER).

212 NYS 2d 671-675 (NY Sup Ct 1961).

escriptors: \*Judicial decisions, \*New York, \*Repulsion (Legal aspects), \*Surface runoff, Surface drainage, Rainwater, Ditches, Water law, Water rights.

Plaintiff, operator of a drive-in theater on one side of a road, brought suit against defendant, who owned a shopping center on the opposite side. Plaintiff asked for money damages as a result of flooding which it alleged was due to a nuisance on defendants' property. Defendants' land was higher than plaintiff's. Plaintiff alleged that due to grading, construction of a building and parking lot, and an advantage of the property of inadequate drainage system, large quantities of water overflowed into a natural gulley and were discharged across the street onto plaintiff's property. The court, following the common enemy rule, held for defendant. Defendant's improvements were made in good faith, and liability would not attach even though the grading and paving directed the flow of surface water toward plaintiff's property and accellerated such flow. Even if the drainage system was inadequate, the natural flow was nevertheless onto plaintiff's property, and defendant did not discharge any water by artificial pipes or ditches. (Williams-Fla)
W69-02741

#### 4B. Groundwater Management

FRANTZ V COLLINS (RIGHT TO USE A **WELL). 21 III 2d 446, 173 NE 2d 437-440 (1961).** 

Descriptors: \*Water supply, \*Water rights, \*Easements, Wells, Real property, Legal aspects, Pipes, Conduits, Judicial decisions, \*Domestic water. Identifiers: Implied easements

Plaintiffs brought action to enjoin defendants from interfering with plaintiffs' right to pipe water to his

residence from a well located on the defendants' property. The property belonging to each party originally constituted a single tract owned by a building contractor. The contractor dug the well in the middle of the tract and subsequently sold one half of the tract to plaintiffs and defendants respectively, intending the well to serve each parcel. A later survey determined that the well was entirely on the defendants' property. The court noted that it is generally held that where the owner of a single tract has arranged or adapted it so that one portion derives a benefit from the other of an apparent and continuous character and then sells one of such parts without mention being made of these incidental uses, the grantee takes his property with all the rights and obligations which formerly existed. Here, at the date of the defendants' conveyance, an easement for the taking and transmitting of water from the well was impliedly reserved by the contractor for the remaining parcel. (Horner-Fla) W69-02444

## CRANE V BOROUGH OF ESSEX FELLS (POWER OF A MUNICIPALITY TO ACOUIRE WATER RIGHTS BEYOND ITS TERRITORIAL

67 Super 83, 169 A 2d 845-852 (1961).

Descriptors: \*New Jersey, Judicial decisions, \*Wells, Subsurface investigations, \*Cities, Condemnation, Eminent domain, Water demand, Water allocation (Policy), Water resources, \*Competing uses, Relative rights, Legislation, Percolations water ing water.

Identifiers: Injunctions.

Action by landowners to enjoin the defendant borough from conducting a 72-hour pumping test of a well that the borough had drilled outside its territorial limits. The landowners alleged that the test rendered their private wells useless, and contended that permanent use of the new well would effectively deprive them of a water supply. The Superior Court ruled in favor of the borough in denying the request for a permanent injunction. The court added that the borough must comply with requisite administrative requirements before unilaterally acquiring additional diversion rights. If the borough complied by seeking administrative approval, the court would not enjoin reasonable tests by the borough, seeking additional water sources. It was held that there was nothing to prevent a borough from seeking new water sources even if some of the new water was to be sold to nearby municipalities, and not used solely by the applying borough. The borough would, however, be bound by the doctrine of reasonable use and could not withdraw underground waters if withdrawal impaired reasonable uses of subsurface water by neighboring landowners. (Blunt-Fla) W69-02456

#### SOUTH RIVER TIDAL DAM PROJECT, SPE-CIAL REPORT 21.

New Jersey State Dept. of Conservation and Economic Development.

N J Dep of Conserv and Econ Dev, Div of Water Policy and Supply, Spec Rep 21, Part 1, Intro and obj, 52 p; Part 2, Engr Rep, 61 p, 1965. 12 fig, 39 plate, 5 tab, 10 ref.

Descriptors: \*Artificial recharge, \*Aquifers, \*Sands, \*New Jersey, Dams, Reservoirs, Saline water intrusion, Cost analysis, Computer models, Digital computers, Water yield, Water quality, Reservoir silting, Sediment control.

Identifiers: \*Recharge reservoirs, Bottom prepara-

A tidal dam is proposed for the South River, New Jersey, to prevent saline water from moving up-stream and to impound fresh stream water in a permeable-bottomed reservoir to recharge the Old Bridge Sand aquifer. The aquifer is presently over-pumped and saline water intrusion is becoming a

problem. The recharge pond would provide about 30 mgd additional yield to the aquifer and would also have limited recreational use. Total pumpage in 1961 was over 30 mgd, about the natural recharge of the aquifer. The project would about double the safe yield and reduce the amount of saline water intrusion. Detailed plans for construction of the project are included. A digital computer model analysis of the extent and character of benefits was made in cooperation with the U.S. Geological Survey and the results are included. Total cost is estimated to be \$4,700,000. (Knapp-USGS) W69-02506

## WATER-LEVEL TRENDS IN SOUTHEASTERN

LOUISIANA, Geological Survey, Baton Rouge, La. Water Resources Div For primary bibliographic entry see Field 02F.

For abstract, see. W69-02513

#### GROUNDWATER MANAGEMENT UNDER QUADRATIC CRITERION FUNCTIONS,

Missouri Univ., Columbia. Dept. of Agricultural Economics.

Oscar R. Burt.

Water Resources Research, Vol 3, No 3, pp 673-682, Third Quarter 1967. 10 p, 8 ref.

Descriptors: \*Groundwater, \*Management, Recharge, Probability, Water supply, Costs, Equilibrium.

Identifiers: \*Quadratic criterion function, Net output, Optimal decision rule, Diminishing returns.

Temporal allocation of groundwater is analyzed for quadratic measures of economic net output from a basin. The two variables of the net output function are rate of use and quantity of stocks. It is shown that an optimal policy for groundwater utilization over time is dependent upon the mean recharge rate but not on higher moments of its probability distribution for the case of quadratic criterion func-tions, provided that inequality constraints on rate of use are unnecessary. The optimal policy is derived, and some analysis of the probability distribution of groundwater stocks is made. Some consideration is given to approximating optimal poli-cies for the situation arising when inequality constraints on rate of use are binding. (Seneca-Rutgers) W69-02537

#### PLANNING FOR GROUND WATER BASIN MANAGEMENT,

California State Dept. of Water Resources, Sacramento.

Albert J. Dolcini.

Proceedings of the Third Annual American Water Resources Conference, 1967, pp 208-214, 7 p.

Descriptors: \*Planning, Water resources development, \*Water management (Applied), \*California, State government, Waste disposal, Saline water intrusion, Water quality, Injection, Separation techniques, Benefits, Costs, Model studies. Identifiers: Incentives, \*California Department of

Water Resources.

In the past much of the development of the ground water resources in California was not planned. At the present time the California Department of Water Resources is attempting to provide for the protection and planned management of the state's ground water resources. Plans for ground water basin management must not concern only quantity. Other problems which have become serious in California are the intrusion of sea water and saline connate water into ground water aquifers and pollution resulting from disposal of solid decomposable refuse in alluvial areas. Moreover, continued overdraft in certain interior ground water basins causes the problem of accretion of salts by reduction or elimination of subsurface outflow from the

## Field 04—WATER QUANTITY MANAGEMENT AND CONTROL

## Group 4B—Groundwater Management

basin. Ground water basin management must be premised on the principle of total resource management--the full use of underground supplies and storage capacity, together with local and imported surface water to satisfy most effectively present and future water demands. Ground water basin management studies provide information useful to a local agency in the selection of an economical management plan. (Seneca-Rutgers) W69-02544

SEEPAGE UNDER SHEET PILES,

Birmingham Univ. (England). For primary bibliographic entry see Field 04A. For abstract, see . W69-02574

#### EFFECT OF RIVER WATER QUALITY ON AN ADJACENT AQUIFER,

Cincinnati Univ., Ohio. Herbert C. Preul, and L. V. Popat. Systems Approach to Water Quality in the Great Lakes, Proc 3rd Annu Symp Water Resources Res, pp 73-96, Ohio State Univ, Sept 1967. 24 p, 11 fig, 5 tab 8 ref

Descriptors: \*Water quality, models, Induced infiltration, Recharge, \*Surfacegroundwater relationships, Observation wells, Water levels, \*Water wells, Water supply, Aquifers, Ion exchange, Pollutants, Pollutant identification, Adsorption, Water chemistry, Darcy's Law, Permeability, \*River flow.

Identifiers: Great Miami River, S.W. Ohio Water Company, Network analysis.

Predictive mathematical models used to determine the quantity and quality of recharge from the Great Miami River to collector wells were presented. The quantity model, based on a simplified node-network model, representing ground basin dynamics based on Darcy's law, was a linear difference-dif-ferential model using one-half year as the increment of time. The concentration of pollutants was determined as the sum of concentrations introduced by the convective flux between the river and well. Calculated pollutant concentrations were tabled, and compared with measured concentra-tions. It was concluded that a high percentage of the water recharging the two collector wells originates from the river, and that the pollutant in-hibitory capabilities of the aquifer, in the form of adsorption and ion exchange, were nearly exhausted. (Gysi-Cornell) W69-02611

## REVITALIZING A FERTILE PLAIN,

Harvard Univ., Cambridge, Mass. For primary bibliographic entry see Field 06A. For abstract, see. W69-02620

CHAPTERS 6-10: PERCOLATING GROUND-WATER; SUBTERRANEAN WATERCOURSES; SPRINGS; SURFACE WATER; DRAINAGE, Illinois Univ., Urbana; and Economic Research Service, Washington, D. C.

For primary bibliographic entry see Field 06E.

For abstract, see W69-02627

## WATER WELL CONTRACTOR'S LICENSE

N C Gen Stat sec 87-65--87-70 (1964).

Descriptors: \*North Carolina, \*Legislation, Wells, \*Administrative agencies, \*Well permits, Well regulations, Permits, Pumps, Drilling equipment, Water resources, Public health, Water law.

The Board of Water Well Contract Examiners is created. No water well contractor may operate within the state of North Carolina unless he is

licensed by the Board. The contractor must also obtain a permit from the board each year for every drilling rig he operates within the state. The Board is comprised of four water well contractors, along with one employee of the State Department of Water Resources, one employee of the State Board of Health, and one representative of the public. The board members serve three year terms. The section does not apply: (1) to an individual who drills a water well on land which is owned or leased by him and is used for farming purposes or as his residence; (2) to an individual who performs labor or services for a licensed water well contractor at his direction and under his personal supervision; and (3) to an individual who, by hand, digs, bores, washes, drives, jets, cores, repairs, or cleans wells without the use of power equipment. (Watson-Fla) W69-02633

# MACARTOR V GRAYLYN CREST III SWIM CLUB, INC. (ACCESS TO NEIGHBORING WATER SUPPLY). 173 A 2d 344-346 (1961).

Descriptors: \*Ownership of beds, Preferences, \*Water rights, Water law, Diversion, \*Well regulation, \*Delaware, Judicial decisions.

Plaintiff sought to enjoin defendant from pumping water from the well which was connected to the water source on plaintiff's property or to compel defendant to provide a permanent alternate source for plaintiffs. Defendants sunk a well approximately 170 feet deep on property adjacent to plaintiff's land to supply a swimming pool with a capacity of 200,000 gallons. After defendants began pumping from their well, plaintiff's six foot deep well went dry. The court noted that Delaware is without precedent in the case and that English common law prior to separation from the Crown would not fill this void. It then noted that there is a proliferation of American doctrines, all rejecting the present British doctrine of absolute ownership. Some American courts have merely modified the English rule requiring that the use be without waste and malice, citing Texas and Rhode Island. California has taken a position which would require proration of water among competing landowners without regard to reasonable use. Between these two extremes lies the rather amorophous 'reasonable use' doctrine which has been subdivided into several categories. The court seemed inclined to favor a position which would reflect a 'practical adjust-ment of conflicting interests,' but deferred ruling on the matter until the trial. (Dann-Fla)

CLOGGING AND CONTAMINATION PROCESSES IN RECHARGE WELLS, Technion Israel Institute of Tech., Haifa; and Water Planning for Israel Ltd., Tel Aviv. M. Rebhun, and J. Schwartz.

Water Resources Res Vol 4, No 6, pp 1207-1217, December 1968. 11 p, 5 fig, 7 tab, 8 ref.

Descriptors: \*Artificial recharge, \*Recharge wells, Pacteria, \*Organic matter, \*Compatibility, Pumping, Performance, Efficiencies, Reliability, Laboratory tests, Water pollution. Identifiers: \*Israel, Coastal aquifer, Lake Kinnereth, Clogging, Well redevelopment, Bacterial

Artificial recharge of production wells by water from a lake is practiced in Israel on a large scale. The observed clogging of recharge wells and contamination of water pumped in dual purpose wells are attributed to small concentrations of organic suspended matter in recharge water. Processes surveyed in the field and simulated in a laboratory column system lead to the conclusion that organics are filtered out near the recharging well, reducing Hydraulic conductivity in fine textured aquifers.

Bacterial contamination and organic material decomposition are inhibited until recharge termination, as growth control components are present in recharge water. A short time after recharge termination (about 2 days) conditions become favorable to organic material decomposition and bacterial growth. High coliform bacteria counts are observed for about 50 days. To avoid the difficulties encountered, it is suggested that recharge wells be redeveloped by small volume pumpage. W69-02669

#### GEOLOGY AND GROUND-WATER RESOURCES OF THE DEER LODGE VALLEY **GROUND-WATER** MONTANA,

Geological Survey, Washington, D. C. For primary bibliographic entry see Field 02F. For abstract, see . W69-02686

# STATE V MARTIN (CONSTITUTIONALITY OF STATUTE REQUIRING WELL DRILLERS TO SUBMIT LOGS).

For primary bibliographic entry see Field 06E. For abstract, see.

## PREDICTING RETURN FLOWS FROM IR-RIGATION,

Bureau of Reclamation, Denver, Colo.

Patrick A. Hurley

Jour Irrig and Drain Div, ASCE, Vol 94, No IR 1, Proc Paper 5838, pp 41-48, March 1968. 8 p, 3 fig,

Descriptors: \*Return flow, \*Aquifer characteristics, \*Analytical techniques, New Mexico, \*Percolating water, Equations. Discharge measurement, Drainage, \*Irrigation water, Transmissivity, Drainage, Reservoir storage, Monthly. Identifiers: Mesilla Valley (New Mexico).

An analytical method for computing return flow or drainage from irrigation applications was presented and discussed. Computations considered aquifer properties, drain spacing, and deep percolation. A graph for determining the fractional part of percolation remaining in transient storage was cluded. Realistic estimates of irrigation return flow could be determined by using the graph and simple digital procedures. The method was used to determine monthly quantities for 13 years of return flows in the Mesilla Valley, New Mexico. (Affleck-Arizona) W69-02762

## 4C. Effects on Water OF Man's Non-Water Activities

#### URBAN HYDROLOGIC RELATIONSHIPS. Maine Univ., Orono. For primary bibliographic entry see Field 02A.

For abstract, see W69-02408

#### MEIER V FRANK MASHUDA COMPANY (SUR-FACE DRAINAGE).

168 NE 2d 319-323 (Ohio 1959).

Descriptors: \*Ohio, State governments, Surface water, Ditches, Drainage water, \*Surface drainage, \*Alteration of flow, Surface runoff, Water law, Paving, Roads, Excavation, Highways, \*Road construction, Graded, Erosion control, Flood damage, Floods, Judicial decisions, Legal aspects.

Defendant had a contract with the state of Ohio to construct a portion of the new, or relocated, state road. In the course of that construction, certain road. In the course of that construction, certain grading, excavating, and laying of draintile was undertaken across from plaintiff's farm. Plaintiff alleged that the work done by defendant changed the flow of surface waters by diverting them to the western edge of the state road where, by reason of

## WATER QUANTITY MANAGEMENT AND CONTROL—Field 04

## Effects on Water of Man's Non-Water Activities—Group 4C

the filling of the ditch by Mashuda, surface waters were diverted to the eastern side of the road and thence over plaintiff's lands and into his barn. The court held that the evidence presented at trial was in conflict and that the jury could properly determine that defendant's conduct constituted negligence proximately causing injury to plaintiff. The court also held that the immunity from suit attaching to a contractor carrying out an agreement with a public body does not extend to one who is guilty of negligence in the performance of such contract. (Smith-Fla) W69-02442

## SPRING VALLEY WATER WORKS AND SUPPLY CO V WILM (DIVERSION OF RIVER

218 NYS 2d 800-802 (1961).

Descriptors: \*New York, Judicial decisions, City planning, Indirect costs, Diversion, \*Riparian rights, Riparian land, Compensation, \*Projects, Public benefits, Legal aspects, Local governments. Identifiers: Indemnity, Public necessity.

Petitioners sought to annual a determination by the Water Power and Control Commission which approved a village's application for increased diversion of river water. Petitioners, riparian land owners, alleged that the village had insufficient provisions to make payment for legal damages to persons and property which would result from the proposed water diversion. Petitioners further charged that the project was not justified by public necessity. The court unanimously rejected these contentions upholding the commission's finding that there existed adequate financial resources in the village to indemnify petitioners and a sufficient potential public need to warrant the water diversion project. (Sisserson-Fla) W69-02446

## SCHROEDER V CITY OF NEW YORK (ADEQUACY OF CONSTRUCTIVE NOTICE IN **DIVERSION PROCEEDING).**

14 App Div 2d 183, 217 NYS 2d 975-977 (1961).

Descriptors: \*Judicial decisions, Diversion, Riparian rights, \*Alteration of flow, Cities, New York, Adjudication procedure, Administrative agencies, Remedies, Riparian land, Legal aspects. Identifiers: Injunctions.

The plaintiff, a riparian owner downstream from the defendant city, sought to enjoin defendant's diversion of stream waters. Defendant had served constructive notice upon the downstream owners, in various ways, for a period of six weeks prior to the diversion proceedings. The trial court granted the defendant's motion for judgment on the pleadings and this court affirmed. The court held that the city's action in providing constructive notice was in compliance with the Administrative Code. The court held further that the constructive notice was reasonable calculated to provide the plaintiff with actual notice of the city's intentions. Such notice was sufficient, in this type of action, to satisfy the notice requirements of both the New York and Federal Constitutions. (Blunt-Fla) W69-02447

## MANITTA V TOWN OF GEDDES (SURFACE DRAINAGE BY DITCH).

14 App Div 2d 504, 217 NYS 2d 383-384 (1961).

Descriptors: \*Judicial decisions, Drainage systems, Descriptors: "Judicial decisions, Drainage systems,
"Ditches, Waste water disposal, "Riddance (Legal
aspects), Municipal wastes, "Waste water
(Drainage), Sewage disposal, "Water pollution
sources, New York, Adjudication procedure.
Identifiers: Injunctions, Restraining orders.

The trial judge issued an injunction forbidding the defendant town to use a drainage ditch for the

removal of excess water. Plaintiff had complained that such use by the town, coupled with the additional discharge of domestic sewage into the ditch, caused the channel to overflow onto the plaintiff's land. This court reversed and remanded the cause for further proceedings which should take into account the ability of the ditch to carry off this excess surface water after the completion of the pending sanitary sewage system. The court stated that the injunction was too broad in that it prevented any use of the ditch by the defendant. The town should be permitted to use the ditch if such use is within the extent of the natural capacities of the ditch. W69-02448

#### COOK V STATE OF NEW YORK (FLOOD DAMAGE).

209 NYS 2d 588-591 (1961).

Descriptors: Floods, Flood control, \*Flood damage, Flood routing, Flood protection, Flood plains, Floodways, \*Streams, Levees, \*Dikes, Embankments, Diversion structures, Natural flow, Judicial decisions, \*New York. Identifiers: \*Castle creek.

As part of a highway improvement program, the state constructed an artificial embankment, which resulted in the diversion of creek waters from their natural course. An artificial dike was constructed at approximately the same height as the original embankment. Continuous heavy rainfall resulted in the washing-out of a portion of the artificial em-bankment. Plaintiff's lands were flooded, and he suffered property damages for which he seeks recovery from the State on the ground of negligence in the construction and maintenance of the dike. The court held that the evidence established that the damage sustained by plaintiff was the result of flooding caused by an Act of God and was not the result of negligence on the part of the state. (Carruthers-Fla) W69-02449

## YARDVILLE ESTATES INC V CITY OF TRENTON (INSTALLATION OF WATER WATER MAINS).

168 A 2d 429-436 (1961).

Descriptors: \*Public utilities, \*Water supply, \*New Jersey, Legislation, Cities, Utilities, Conduits, Water conveyance, Legal aspects, Contracts, Judicial decisions, \*Water contracts, Water require-

Plaintiff development corporation brought suit to recover the cost of water mains installed by the plaintiff to connect its housing development with the water distribution system of defendant city. The plaintiff agreed to install the mains at its own expense as required by a city resolution. The court held that the city had statutory authority to con-tract for the construction of mains at the expense of those seeking water supply. The city may not impose discriminatory or illegal conditions upon users. Here, it did not; but even if it had, the plaintiff would be stopped from asserting that the defen-dant had abused its discretion because the plaintiff voluntarily entered into the contract. (Horner-Fla.)
W69-02451

## GILL V FIRST CHRISTIAN CHURCH, ATLAN-TA, GEORGIA, INC (CONSTRUCTION CAUSING INCREASED SURFACE RUNOFF AND DAMAGE).

117 SE 2d 164-166 (Ga 1960).

Descriptors: \*Judicial decisions, Georgia, Natural flow, Doctrine, \*Relative rights, Flood damage, Damages, \*Surface water, Deposition (Sediments), Mud, \*Running water, Soils, Judicial decisions, Legal aspects.

Identifiers: Trespass, Debris.

In a trespass action against the defendant church and its general contractor, plaintiff alleged that defendants caused water to accumulate in unnatural amounts upon the church property, which water flowed periodically down upon the plaintiff's land, carrying with it dirt, silt, and debris, and doing damage to the plaintiff's property. The trial court sustained the contractor's general demurrer to the plaintiff's petition. The contractor relied on the fact that it had completed construction and turned the building over to defendant church before plaintiff brought this action and, thus, could not be held liable along with the church. The plaintiff averred that she had called the conditions to the attention of the contractor several times without satisfaction during the course of the construction. This court reversed stating that one who commits a trespass upon the land of another is subject to be sued as a trespasser whether he is acting for himself or as an agent of another, and, if the agent commits the trespass while under the direction of a principal, both may be sued. Church had no right to concentrate the water on its land in greater than natural amounts and cause it to be discharged upon the plaintiff's land in a manner different from its natural flow. (Blunt-Fla) W69-02454

## ATTORAM REALTY CORP V TOWN AND COUNTRY BUILDERS (LIABILITY FOR SUR-FACE RUNOFF DAMAGE).

178 NYS 2d 105-109 (S Ct 1958).

Descriptors: \*New York, Judicial decisions, \*Drains, Pipes, \*Surface runoff, Surface drainage, Drainage, Gullies, Erosion, \*Land development, Water law, Diversion, Surface waters, Damages, Natural flow, Drainage systems, Ditches.

Plaintiff brought suit to enjoin defendant from diverting and discharging surface waters onto his land, and for damages. In connection with its development of adjacent land, defendant constructed a drainage system which discharged surface waters on plaintiff's land through three pipes. The supreme court found that plaintiff's land had not been damaged by the flow of surface water prior to the construction of the drainage system, and that it was materially damaged thereafter. The court held that defendant's action was the proximate cause of plaintiff's injury, and that the defendant should have reasonably foreseen such damage. One may improve his land through natural and normal alterations, and cause surface waters to be cast on the lands of another without liability, unless the surface waters are collected in drains, pipes or ditches to be cast on the other's premises. This rule established defendant's liability. The measure of damages was the cost of restoration of plaintiff's property, in the absence of evidence of diminution of market value. (Williams-Fla)
W69-02466

# WRIGHT V ROANE COUNTY (ACTION TO ENJOIN COUNTY FROM FLOODING LANDS BY ROAD CONSTRUCTION). 315 S W 2d 97-98 (Tenn 1958).

Descriptors: \*Tennessee, Judicial decisions, \*Jurisdiction, Highways, \*Flooding, Surface runoff, Eminent domain, \*Road construction, Right-of-Eminent domain, \*Road con: way, Legal aspects, Remedies. Identifiers: \*Injunction, Equity.

A bill in equity was filed by a number of property owners against the county seeking relief on the ground that as a result of certain reconstruction of ground that as a result of certain reconstruction of a federal highway, the plaintiffs' lands, which were not condemned, were being flooded. The Chancery Court dismissed the bill and the plaintiffs appealed. The Supreme Court of Tennessee held that the Chancery Court was without jurisdiction to enjoin the county to go upon the rights of way of the state and federal government and change the construction of a federal highway. If the complainants had any claim against the county, they had a plain and adequate remedy at law. (Watson-Fla) W69-02635

## Field 04 - WATER QUANTITY MANAGEMENT AND CONTROL

## Group 4C - Effects on Water of Man's Non-Water Activities

SHERMAN V STATE (CONDEMNATION VALUE OF MUCK SOILS).

174 NYS 2d 736-738 (Ct Cl 1958).

Descriptors: \*Muck soils, \*New York, Condemnation, Easement, \*Condemnation value, Legal aspects, Judicial decisions, Highways, Crops, Vegetable crops, Drainage, \*Road construction, Damages, Moisture content, Boreholes, Eminent domain.

Identifiers: Inverse condemnation.

Claimant, the owner of land appropriated by the state, brought action for compensation. The state produced experts who testified that parts of the unsuitable land appropriated were 'muck lands. for growing crops. Claimant established by satisfacevidence that crops had, in fact, been grown on the land. Claimant also contended that since the state constructed its road on the land, drainage has been inadequate and that the fields remain wet for a longer period than usual in the spring. The court did not attempt to classify the soil as 'muck' or 'not muck.' Claimant's damage was limited to the actual fee taking, the permanent easement, and the damage suffered by the taking of tillable acreage as it affects the total value. If, because of the construction of the new road, drainage is now in-adequate and the fields remain wet for a longer period than before the appropriation, such condition would constitute a continuing trespass. (Bozarth-Fla) W69-02640

## HUIE V KLASS (COMPENSATION TO LICENSEE OF RIPARIAN OWNERS).

11 App Div 837, 202 NYS 2d 954-956 (1960).

Descriptors: \*Judicial decisions, \*New York, Administrative decisions, \*Administrative agencies, Condemnation, \*Compensation, Riparian rights, Eminent domain, Cities, Water law, Land use. Identifiers: Permissive rights.

The New York City Board of Water Supply sought to acquire additional land and alter the flow of a river to provide an additional supply of water for the city. The commissioners of appraisal allowed damages to four claimants whose land was not taken and who had neither legal title to riparian rights in the river nor any easements. The claimants used the river water as licensees of the riparian owners and suffered a business loss due to the city's utilization of the river. The New York Administrative Code's condemnation provision, much broader than the usual condemnation statute, provided for compensation to the owner of an established business which is directly or indirectly damaged by ex-ecution of the city's plans. The Supreme Court, Special Division, issued an order pursuant to the commissioners' findings. On appeal by the Board of Water Supply, the Supreme Court, Appellate Division, held that the language of the code was sufficient, and the code was sufficient to the code was sufficie ciently broad to require compensation for permissive rights to water exercised for business purposes. (Williams-Fla) W69-02661

## SPIELBERGER V TWELFTH DAYTON BUILDERS CORP (RIGHT OF SURFACE WATER DRAINAGE).

142 NE 2d 561-566 (C P Ohio 1956).

Descriptors: \*Ohio, Judicial decisions, \*Storm drains, Surface runoff, Small watershed, \*Relative rights, Land use, \*Natural flow, Land development, Drainage systems, Surface drainage, Ditches, Drainage water, Obstruction to flow, Legal aspects, Diversion structures.

Defendants developed, for residential purposes, lands which were higher than the lands of plaintiffs'. Defendant developers established stormwater drainage systems which increased the flow in natural and pre-existing drainage ditches, which led

through the lower lands. Lower property owners brought suit for injunctive relief from damage caused by the increased flow. The Court of Common Pleas, Montgomery County, found that there had been no diversion of water on, to, or from the lands of the defendants, that the defendants were not negligent, that the use and development for residential purposes was reasonable and proper, and that the lower owners contributed to damages by failure to correct barriers and bottlenecks to the increased flow. The Court held that the right to require lower landowners to receive naturally draining surface waters is a right incident to owner-ship of the higher lands. The defendants were permitted to drain surface water into the natural outlets. (Wheeler-Florida) W69-02698

## KUKLINSKA V MAPLEWOOD HOMES, INC. (RIGHT OF SURFACE WATER DRAINAGE). 146 NE 2d 523-528 (Mass Sup Jud Ct 1957).

Descriptors: \*Massachusetts, Judicial decisions, \*Surface runoff, Prescriptive right, \*Land development, Drainage systems, \*Relative rights, Artificial watercourses, \*Land reclamation, Surface drainage, Drainage water, Pipes, Swamps, Landfills.

Defendant developed, for residential purposes, lands located above lands of the plaintiff. Water formerly flowed through two swamps located partially on defendant's land and eventually flowed onto plaintiff's land. The defendant filled and developed the swamps and installed a concrete pipe drain to carry the flow. Defendant installed portions of the pipe through a long, pre-existing drainage ditch. The flow was discharged upon defendant's land at a point over which water formerly passed on its way to the lower lands of plaintiff. Plaintiff sued to enjoin construction of the drain which caused water to flow to the plaintiff's land. The trial court held that the drainage system did not materially increase the flow of water onto the plaintiff's land. There was evidence that the land filling actually reduced the flow. The Supreme Judicial Court held that a landowner may improve his land by changes in grade, even if the natural course of surface water is thereby changed, so long as the water is not discharged on another's land by definite, artificial channels. The Court precluded plaintiff from establishing that the discharge was through artificial channels, noting that the ditch had been present for at least 150 years. (Wheeler-Florida) W69-02699

# LA LICATA V VILLAGE OF SANDS POINT (DRAINAGE OF SURFACE WATERS). 174 NYS 2d 305-308 (Sup Ct 1958).

Descriptors: \*New York, \*Surface drainage, Grassed waterways, Culverts, Surface runoff, Drainage water, Precipitation excess, Legal aspects, Judicial decisions, Drainage systems, Operation and maintenance, Drainage effects, Drainage practices, \*Ditches, \*Conduits, Tubes, Discharge (Water), Natural flow, Grading, Embankments, Erosion, Erosion control, Topsoil, Easements. Identifiers: Debris.

Plaintiff brought action for an injunction restraining a municipal corporation from collecting surface waters in a drainage ditch alongside a road and from discharging them upon his property. The ditch ran parallel to the boundary of plaintiff's property, and he alleges that the discharge of surface water upon his land washed away top soil and prevented seeding. Sometime after purchasing the property, plaintiff built a driveway across the ditch, obstructing the natural flow of water, thus causing it to flow to the elevation of the driveway and then run onto his land. The injunction was denied, but the court retained jurisdiction ordering the defendant to straighten, grade, and clean the ditch of debris. Plaintiff was instructed to install a conduit

under his driveway and to grade up his land near the roadway so as to prevent overflowing. (Bozarth-Fla)
W69-02717

#### RAILROADS; DRAINS.

La R S 45:451-458 (1965).

Descriptors: \*Louisiana, Adjudication procedure, Right-of-way, State governments, \*Railroads, \*Drainage, Topography, \*Remedies, Legislation, Surface drainage, Legal aspects, Compensation. Identifiers: Roadbeds.

All railway companies must do whatever is necessary to drain all railroad roadbeds which obstruct or interfere with the natural drainage of any land traversed by the railroad. If this is not done, the landowner may do the work at his own expense and receive reimbursement from the railway company by complying with certain statutory procedures. Provision is made for certain remedial actions and for penalties for noncompliance with the statute. (Scott-Fla) W69-02721

#### **PUBLIC UTILITIES - CARRIERS; RAILROADS.**

La R S 45:324 (1965).

Descriptors: \*Louisiana, State governments, \*Roads, Transportation, Agricultural watersheds, \*Drainage, Bridges, Railroads, \*Navigation, Legislation.

Wherever railroads or other types of roads cross any agricultural land, said road should be constructed in such a manner so as not to interfere with drainage of the land. Should such roads cross any body or stream of water, a bridge for crossing may be erected for the exclusive use of such road so long as the bridge does not obstruct or unnecessarily interfere with navigation of such waters. (Scott-Fla)

## IMPROVEMENTS FOR RECREATIONAL PUR-

La R S 41:1505 (1965).

Descriptors: \*Louisiana, Legislation, Administrative agencies, Lakes, \*Permits, \*Recreation facilities, State governments, \*Construction, Exploitation, Leases.

The Register of the State Land Office is authorized to issue permits to make improvements for recreational purposes and to use or permit others to use such improvements. Such permits are for improvements to meandered lakes to which the state has title. All permits are subject to existing leases and wild life laws. (Childs-Fla) W69-02723

## 4D. Watershed Protection

EROSION CONTROL IN RELATION TO WATERSHED MANAGEMENT, Soil Conservation Service, Washington, D. C. William R. Moore, and C. Edwin Smith.
Proc Amer Soc Civ Eng, J Irrig Drain Div, Vol 94, No IR3, pp 321-331, Sept 1968. 11 p, 4 fig, 2 tab, 8 ref, append.

Descriptors: \*Erosion control, \*Watersheds, \*Erosion, Land management, Sedimentation, Soil erosion, Sediments, Runoff, Surface runoff, Losses, Benefits, Water quality, Costs, Land reclamation, Flood control, Channel erosion, Sheet erosion, \*Watershed management, Small watersheds, Wind erosion.

Identifiers: Cost savings.

## Identification of Pollutants — Group 5A

Erosion control is a significant factor in effective management of watershed lands. Erosion and sediment problems in the United States annually amount to over \$1 billion loss or about one-fourth of all soil and water losses. Sediment problems and sources and magnitude of sheet erosion, channel erosion, and wind erosion are described. Kinds and effectiveness of land treatment measures are explained. The effectiveness and status of the small watershed approach to controlling erosion and developing water resources in these areas are set forth. Of an estimated 8300 potentially feasible small watershed projects, needed land treatment measures had been installed in 323 projects by June 30, 1966, since the enactment of the Watershed Protection and Flood Prevention Act, PL-566, in 1954. During that time, almost 6,000,000 acres had been treated with erosion control practices. Erosion control benefits from these practices and other sediment control measures are estimated to have been almost \$52,000,000 by June 30, 1966. (USBR) W69-02566

#### DYNAMIC PROGRAMMING METHODS AP-PLIED TO PROBLEMS. WATERSHED MANAGEMENT

California Univ., Los Angeles. For primary bibliographic entry see Field 06A. For abstract, see . W69-02622

#### SOIL CONSERVATION DISTRICTS (LEGISLA-TIVE DETERMINATIONS AND DECLARATION OF POLICY).

LSA-RS 3:1201 (1965).

Descriptors: \*Louisiana, Legislation, \*Soil management, \*Soil erosion, Terracing, \*Erosion control, Dams, Dikes, Strip-cropping, Reforestation, Run-off, Flood control, Reservoirs, Navigability, Legal aspects.

In order to conserve soil resources and control and prevent soil erosion, the legislature discourages land use policies contributing to soil wastage and erosion and recognizes that appropriate policies be carried out. Among the procedures necessary for adoption are engineering operations such as terracing, check dams, dikes, ponds, and ditches. Utiliza-tion of strip cropping, lister furrowing, contour cultivating and furrowing, land irrigation, seedling of waste or abandoned lands, and retardation of runoff are desirable. The legislature declares its policy to be: (1) to conserve soil resources; (2) to control and prevent soil erosion; (3) to control floods; (4) to prevent impairment of dams and reservoirs; and (5) to assist in the navigability of rivers and harbors. (Childs-Fla) W69-02730

## 05. WATER OUALITY MANAGEMENT AND **PROTECTION**

## 5A. Identification **OF** Pollutants

DIGITAL TRANSMISSION OF COLLECTED WATER QUALITY DATA,

Arkansas Univ., Little Rock. Dept. of Electronics and Instrumentation.

M. K. Testerman, R. W. Raible, and P. T.

Roberson.

Arkansas Univ, Report of the Arkansas Water Resources Research Center to OWRR, Dept of Interior, September 1968.

Descriptors: \*On-site data collection, Data processing, Data storage and retrieval, \*Data transmission, Instrumentation, \*Monitoring.

Identifiers: \*Water quality data, \*Digital data transmission, Design criteria, Telemetering data, Digital systems, Electronic equipment.

A system which continuously telemeters informa-tion from the remote data collection sites to a central time-shared computer, which in turn makes decisions as to whether the changes taking place are significant can be envisioned, if unlimited funds are available. Cost estimates for such a system are included along with considerations for other types of systems. Using dedicated phone lines is one means of transmitting data from remote collection sites. For many applications the cost of such a system is excessive. Interrogation at fixed intervals allows use of less expensive transmission facilities. At the remote station a programmer and timer are necessary for controlling recording sequences and interrogation is on the order of once every 24 hours. Some consideration is given to recording at preset intervals and also incorporating an alarm system for data collection at more frequent intervals. The theoretical aspects of the sampling process involved in a digital data acquisition system is discussed from the standpoint of taking the criteria and specifications of measuring water quality as set forth by the FWPCA and applying the principles of process control concepts and its attendant problems and criteria. (Roberson-Arkansas) W69-02406

## ELECTROCHEMICAL TRANSDUCERS FOR

WATER QUALITY,
Arkansas Univ., Little Rock. Dept. of Electronics

and Instrumentation.

C. E. Borchers, R. W. Raible, and M. K.

In Analysis Instrumentation, Plenum Press, New York, N.Y. (1964) pp 79-82.

Descriptors: \*Water quality, Water analysis, Dissolved oxygen analyzers, Water properties, \*Moni-

Progress in the development of a self-contained remote water quality monitor is reported. Transducers suitable for this monitor are discussed and the overall monitor composition is presented. (Raible-Arkansas) W69-02407

## RESIDUES IN FISH, WILDLIFE, AND ESTUA-

Massachusetts Div. of Fisheries and Game; and Massachusetts Health Research Inst., Inc., Boston. Lee D. Lyman, William A. Tompkins, and James A. McCann.

Pesticides Monitoring Journal, Vol. 2, No. 3, pp 109-122, Dec. 1968, 14 p, 2 fig, 3 tab, 8 ref.

Descriptors: \*Pesticide residues, Chlorinated hydrocarbon pesticides, Fish, Gas chromatography, Chemical analysis, Water pollution.

Identifiers: \*DDT, Freshwater fish, Sampling, Aquatic environment.

Fish, representing a number of indigenous freshwater species, were collected in all of the major watersheds in Massachusetts during the summers of 1965, 1966, and 1967. Individual analyses of these fish were conducted to determine the concentrations of DDT and its metabolites, DDE and DDD (TDE). A total of 1,310 individual fish specimens were collected and analyzed from 93 stations.

Mean DDT concentrations, based on the analysis of a minimum of five fish per station, ranged from 0.17 to 28.88 ppm. Residues of DDT in individual fish specimens ranged from 0.00 to 49.10 ppm. Comparison of the mean concentrations of DDT between different fish species showed that some species had varying abilities to concentrate DDT. Neither length nor weight was related to pesticide concentration found in yellow perch and pumpkin-seed. Some samples portrayed extreme variation in the concentration of pesticide found in individual fish. Generally, there was an increase in pesticide concentration in fish from the various watersheds

of the state during the three-year study period. All data were expressed in ppm of pesticide found in whole fish, based on dry weight. Conversion factors to change ppm based on dry weight to ppm based on wet weight determined for nine species of fish. (Bridges-Mass Health Res Inst) W69-02411

## GAS CHROMATOGRAPHIC DIFFERENTIA-TION OF CLOSELY RELATED SPECIES OF MICRO-ORGANISMS,

New Mexico State Univ., University Park. William Garner, and Robert N. Gennaro.

Presented to Division of Microbial Chemistry and Technology, American Chemical Society, 150th National Meeting, Atlantic City, New Jersey, Sept. 1968. 6 pp, 13 slides. OWRR Project A-002-NMex.

Descriptors: \*Gas chromatography, \*Bacterial identification, Bacterial fingerprinting, Digit computer identification, Water pollution, Identification of pollutants, \*Pyrolysis of cells.

Identifiers: Water-borne contaminates, Gas chromatography, Bacterial identification.

Gas chromatographic detection and characterization of micro-organisms is based on the assumption that bacterial species vary both in the nature of their constituent compounds and in the relative proportions of these compounds. When these constituent compounds are converted into volatile derivatives by pyrolysis and analyzed by gas chromatography, it is possible to obtain a fingerprint of these constituents which can be converted to digital form for identification of unknown species. Widely varying species of organisms produced chromatograms with considerable differences in retention time of the peaks and relative peak heights. Chromatograms made in this study have shown that whole cells can be pyrolyzed to yield volatiles in a high degree of precision. Six species of the family Enterobacteraceae were grown on two different media. Pyrolysates from these washed, lyophilyzed cells yield chromatograms which are generally similar but in particular show a species uniqueness. These experiments should encourage continued efforts to improve and apply this technique in microbiology. (Hernandez-N Mex State) W69-02484

#### POLLUTION SURVEILLANCE BY NONCON-TACT INFRARED TECHNIQUES, Texas Instruments, Inc., Dallas

For primary bibliographic entry see Field 07B. For abstract, see . W69-02516

#### ULTRAVIOLET ABSORBANCE AS AN INDEX OF THE POLLUTION OF SEAWATER, Tokyo Metropolitan Univ. (Japan).

For primary bibliographic entry see Field 07B. For abstract, see. W69-02517

## A COMPOSITE-GRAB OF WATER POLLU-

TION CONTROL SAMPLING, lowa State Water and Pollution Control, Ames. For primary bibliographic entry see Field 07B. For abstract, see . W69-02519

## LAKE ERIE REPORT: A PLAN FOR WATER POLLUTION CONTROL, Federal Water Pollution Control Administration,

Washington, D. C. For primary bibliographic entry see Field 05C.

For abstract, see . W69-02695

## Field 05 - WATER QUALITY MANAGEMENT AND PROTECTION

## Group 5B - Sources of Pollution

## 5B. Sources of Pollution

## STOCKSTAD V TOWN OF RUTLAND (OB-STRUCTION OF SURFACE WATERS).

8 Wis 2d 528, 99 NW 2d 813-817 (1959).

Descriptors: \*Water pollution, Water law, Legal aspects, Judicial decisions, Local governments, \*Wisconsin, Road construction, \*Cities, Legislation, Deep wells, Domestic water, Ditches, Culverts, Road design, Watercourses (Legal), Obstruction to flow, Natural flow.

Defendants improved a town road abutting Plaintiffs' land. The improvements closed a pre-existing waterway and diverted its course onto Plaintiffs premises, thereby contaminating a deep well used by the plaintiffs for domestic purposes. After drinking from the well and becoming ill with trenchmouth and other diseases, the plaintiffs instituted suit claiming defendants' actions produced a continuing nuisance and violated a state statute. The statute provided a cause of action against a town when obstruction of surface waters caused by road maintenance or construction caused damage to private property. Defendants sought to have the suit dismissed on grounds that the statute did not provide a cause of action for personal injuries. The court held that, although the complaint did not state a cause of action under the statute, sufficient facts had been stated to constitute a cause of action based upon a continuing nuisance. At common law a municipality is not immune from suit when it creates a private nuisance. (Molica-Fla) W69-02429

## DELTA-SUISUN BAY WATER QUALITY AND HYDRAULIC STUDY, San Francisco Bay District, Vallejo, Calif. Dept. of

Water Resources.

For primary bibliographic entry see Field 02L. For abstract, see . W69-02493

# A STUDY OF SALT WATER ENCROACHMENT IN THE COASTAL AQUIFER AT DIGHA, MID-NAPORE DISTRICT, WEST BENGAL, INDIA, Geological Survey, Calcutta (India).

For primary bibliographic entry see Field 02F. For abstract, see . W69-02504

## THE IMPACT OF ANIMAL WASTES ON WATER RESOURCES ACTIVITIES,

Kansas Univ., Lawrence, Kans. Raymond C. Loehr.

Proceedings of the Third Annual American Water Resources Conference, 1967, pp 314-324, 11 p, 2 fig. 2 tab. 28 ref.

Descriptors: \*Animal wastes, Wastes, Water pollution sources, Cattle, Fishkill, Waste disposal, Kansas, Runoff, Nitrogen, Drainage, Diseases, Water

pollution effects. Identifiers: Animal production trends, Animal confinement trends, Organic pollution, Inorganic pol-

Until recently animal wastes have been considered as part of the 'natural' pollution of a region. Animal production is changing from small farm operations into large scale industrial enterprises. There is an increasing trend to confine animals within small areas to produce the greatest weight gain in the shortest period of time. Under such conditions, it is not possible for these animals to drop their wastes on pastures where the wastes can be absorbed by nature without adversely affecting the environ-ment. Animal wastes have been shown to be a major source of surface water pollution. This paper mentions cases of pollution that have been caused by animal wastes and animal production opera-tions. It discusses the trend toward confinement feeding operations and the magnitude of the

problem in the future. It also demonstrates the need to consider animal wastes when developing or protecting water resources. (Seneca-Rutgers) W69-02528

## ASYMMETRY BETWEEN BRIBES AND CHARGES,

Carnegie Inst. of Tech., Pittsburgh, Pa. M. I. Kamien, N. L. Schwartz, and F. T. Dolbear. Water Resources Research, Vol 2, No 1, pp 147-157, First Quarter 1966. 11 p, 2 fig, 14 ref, 3 append.

Descriptors: \*Wastes, Waste disposal, Streams,

Costs, \*Water pollution, Water treatment, Marginal costs, Waste treatment, Profit.
Identifiers: \*Asymmetry, \*Bribes, \*Charges, \*Externalities, Comparative statics, Boundary solution, Interior solution

A classic and increasingly important example of the technological externalities problem is that of a firm discharging waste into a stream, thereby inflicting damages on downstream users of the water. As long as there is no economic or legal incentive to do otherwise, the firm will ignore the effects of this action on others. It has been argued that, asymmetries in income distribution and administration aside, the levying of a charge and the payment of a bribe are symmetric means of internalizing to the firm the externality resulting from its discharge of waste into the stream. It is shown that this symmetry between bribes and charges does not hold when the cost and revenue functions are subject to change, unless these functions are known by the affected parties. Furthermore, a bribe will not only cause the firm to produce at least as much waste matter as under a charge alternative of the same cost but may even induce the firm to produce more waste matter than in the absence of a bribe or a charge. The analysis deals with water pollution for the sake of exposition; the analysis can be extended readily to other situations giving rise to externalities. (Seneca-Rutgers) W69-02534

# EFFECT OF RIVER WATER QUALITY ON AN ADJACENT AQUIFER, Cincinnati Univ., Ohio.

For primary bibliographic entry see Field 04B. For abstract, see . W69-02611

## UNITED STATES V REPUBLIC STEEL CORP (DUMPING OF INDUSTRIAL SOLIDS AND FLUE DUST IN CHANNEL OF NAVIGABLE RIVER).

264 F 2d 289-304 (1959).

Descriptors: \*United States, Judicial decisions, Water Law, Rivers and Harbors Act, Legislation, Navigable waters, \*Industrial wastes, Sediment discharge, Channel, \*Obstruction to flow, Rivers, Sewers, Dredging, Excavation, Wastes, Riparian rights, Legal aspects.

Identifiers: Army Corps of Engineers, Debris.

The United States brought this action to enjoin the discharge of industrial solids and flue dust into the channel of a navigable river and for a mandatory injunction directing that the channel be dredged to the original depth. This is an appeal from a judgment for the United States. The court of appeals held that the deposit of the industrial solids and flue dust did not constitute an 'obstruction' within the meaning of the Rivers and Harbors Appropriation Act of 1899, and did not constitute a 'fill' within the meaning of the provision of that section in the Act, nor did it constitute a violation of the section making unlawful the deposit in navigable waters of any refuse means. ble waters of any refuse matter. Thus, the United States was not entitled to an injunction under the Act or independent of statuatory power. The judgment was reversed. (Childs-Fla) W69-02651

# CLOGGING AND CONTAMINATION PROCESSES IN RECHARGE WELLS, Technion Israel Institute of Tech., Haifa; and Water Planning for Israel Ltd., Tel Aviv. For primary bibliographic entry see Field 04B.

For abstract, see . W69-02669

# MODEL EXPERIMENTS ON FLUID FLOW IN THE TRANSITION ZONE FROM UNSATURATED TO SATURATED SOIL, Bundesanstalt fuer Gewasserkunde, Coblenz,

(West Germany). For primary bibliographic entry see Field 02G. For abstract, see . W69-02681

## 5C. Effects of Pollution

## RESIDUES IN FISH, WILDLIFE, AND ESTUA-

Massachusetts Div. of Fisheries and Game; and Massachusetts Health Research Inst., Inc., Boston. For primary bibliographic entry see Field 05A. For abstract, see. W69-02411

## FRIESLAND V CITY OF LITCHFIELD (DAMAGES FROM UNTREATED SEWAGE).

24 III App 2d 390, 164 NE 2d 606.

Descriptors: Water law, \*Fouling, Accident, Sewage, \*Water pollution sources, Water pollution effects, \*Illinois, Judicial decisions.

Defendant city permitted untreated sewage to flow into a creek which crossed plaintiff's land thereby poisoning his cattle. Plaintiff obtained a judgment in the trial court for his losses and defendant city appealed, assigning inter alia error in admitting cersamples of water taken from the creek some two months after the plaintiff moved from the property. The admission of the testimony was upheld. The interceptor sewer system which ran parallel to the ditch which eventually entered plaintiff's land had applying and allowed rank several the aster and ruptured and allowed raw sewage to enter the ditch. It was also shown that the city had notice of the rupture in the system. (Dann-Fla) W69-02434

# OF NEW YORK STATE, A STUDY OF PHYTOPLANKTON AND NUTRIENTS IN LAKES CAYUGA AND SENECA, New York State Coll. of Agriculture, Ithaca. For primary bibliographic entry see Field 02H. For abstract, see . W69-02488 **EUTROPHICATION OF WATER RESOURCES**

## PIGMENT INDICES AND ENVIRONMENTAL. OXYGEN STRESS, North Carolina Univ., Chapel Hill. Water

Resources Research Inst.
Robert A. Kelly.
Report 12, 1 Oct 1968. 94 p. OWRR Project A025-NC.

Descriptors: \*Water pollution effects, \*Bioindicators, \*Streams, \*Oxygen requirements, \*Benthic fauna, \*Pigments, Eutrophication, Oligotrophy,

fauna, \*Pigments, Eutrophication, Oligotrophy, Spectrophotometry, Analytical techniques, Water pollution sources, Metabolism, Environmental effects, Aeration, Physiology, North Carolina, Water quality, Respiration, Bioassay. Identifiers: Middle Creek (NC), Reeds Creek (NC), Alamance Creek (NC), Big Alamance Creek (NC), Ledge Creek (NC), Kenneth Creek (NC), Eno River (NC), Northeast Creek (NC), Robeson Creek (NC), Walnut Creek (NC), Marlowes Creek (NC), Loves Creek (NC), Richland Creek (NC), Town Creek (NC), North Rock River (NC), Saprobe system, Diversity indices, Hemoglobin indices, Beck's biotic index.

## Effects of Pollution — Group 5C

Samples of benthic animals, taken from 41 stations located above and below sources of organic wastes entering 18 North Carolina streams, were homogenized, centrifuged, and examined spectrophotometrically for presence and relative con-centrations of hemoglobin. Relative low oxygen values were estimated from determinations made at night in spring (39 stations) and summer (30 stations). Four pigment indices were calculated from absorbances at peak wavelengths characteristic for hemoglobin using the following relationships: INDEX ONE= C - (0.6 (B + D)); INDEX TWO= (C - (0.6 (B + D)))/G; INDEX THREE = 1.05 A + 2.50 C - 3.55 B; and INDEX FOUR = (1.05 A -2.50 C - 3.55 B)/G; where A, B, C, and D are absorbances at 405, 500, 540, and 600 millimicrons, respectively, and G is wet weight (grams) of animals in the sample. A trend, not statistically significant, of association of higher hemoglobins with areas with organic wastes and low oxygen was demonstrated. Non-hemoglobin body pigments were found in streams with low concentrations of organic wastes. Data suggested an inverse relationship between non-hemoglobin pigments, found principally in streams with high oxygen concentrations, and hemoglobin pigments. Appendices contain extensive data by stations for absorbances, pig-ment indices, and dissolved oxygen and figures of absorption spectra by stations. W69-02521

ECOLOGICAL SYSTEMS ANALYSIS AND WATER QUALITY,
Oak Ridge National Lab., Tenn.
Bernard C. Patten.

Systems Approach to Water Quality in the Great Lakes, Proc 3rd Annu Symp Water Resources Res, pp 37-45, Ohio State Univ, Sept 1967. 9 p, 18 ref.

Descriptors: \*Ecological distribution, Optimization, \*Systems analysis, \*Water quality, Linear programming, \*Mathematical models, Environmental effects, Ecosystems, Growth rates, Analytical techniques, Aquatic environment, Fluctuation, Ecology.

Identifiers: Optimum diversity, Dynamic behavior.

Several examples of environmental energy and material transfer problems were mathematically structured to illustrate some recent applications of systems analysis techniques to ecological problems system defined as a set of simultaneous differential equations was rewritten in matrix form. It was shown that the 'eigenvector' solution to the problem could be used to determine the transient response to disturbances, the stability, parametric sensitivity and the optimality of the system. Simplified example solutions of the technique were tabled. Single resource-single species, and single resource-multiple species population growth rate equations were defined. The analogy of optimum diversity of species problems to 'shortest route' and 'maximum flow' linear programming network problems was illustrated by a simple example. A species diversity index equation was suggested as a possible method of evaluating water quality. (Gysi-Cornell) W69-02613

OXYGEN DEMAND AND OXYGEN DEPLETION CAPACITY OF SEDIMENTS FROM WAS-SAW SOUND, GEORGIA,

Georgia Univ., Athens. Dirk Frankenberg, and Charles W. Westerfield, Jr.

Bull of Georgia Acad of Sci, V 26, No 4, pp 160-172, Sept 1968. 13 p, 4 tab, 3 chart, 32 ref.

Descriptors: \*Sediments, \*Estuaries, \*Oxygen demand, Salt marshes, Phosphates, Mining, Georgia, Hydrography, Ecosystems, Tidal waters, Tidal

Identifiers: Oxygen depletion capacity, Water-quality deterioration, Organic-rich sediments, Wassaw Sound (Georgia).

Proposed mining of phosphate deposits lying 70 to 120 ft beneath salt marshes and estuaries of Was-

saw Sound, Georgia poses a problem of potential damage to the salt marsh-estuarine ecosystem. Oxygen relationships of water and sediments from assaw Sound were studied to determine potential oxygen-depleting effects of disturbing large quantities of organic-rich sediments. Data collected, evaluated, and tabulated include surface water hydrographic parameters in addition to sediment oxygen demand and depletion capacity. The study shows that the average oxygen demand of sediments from creek bottoms, marshes, creek banks, river bottoms and sound bottom were, respectively, 3.73, 3.25, 2.10, 2.08, and 0.89 mg oxygen per cc sediment during the first 24 hours after disturbance. Conjunctive average oxygen depletion capacities were 986, 766, 515, 477, and 154 cc water depleter per cc of sediment disturbed during the first 24 hours after disturbance. Conclusions of study suggest strongly that severe oxygen depletion of waters in Wassaw Sound could result from disturbance of the sediments. Estimates of oxygen demand liberated by disturbance of sediments attributed to specified mining operations indicate that all the oxygen could be removed from 16 to 27 percent of the low tide volume of Wassaw Sound and its tributaries. (Steinhilber-USGS) W69-02673

#### LIMNOLOGICAL EFFECTS OF ORGANIC EX-TRACTS OF LITTER IN A SOUTHWESTERN IMPOUNDMENT,

Arizona Univ., Tucson. Cooperative Fishery Unit. For primary bibliographic entry see Field 02H. For abstract, see. W69-02687

#### LAKE ERIE REPORT: A PLAN FOR WATER POLLUTION CONTROL.

Federal Water Pollution Control Administration, Washington, D. C.

Fed Water Pollut Contr Admin, Great Lakes Reg, 107 p, Aug 1968. 52 fig, 16 tab, 1 append.

Descriptors: \*Lake Erie, \*Water pollution effects, \*Eutrophication, \*Water pollution control, Water quality control, Hydrogeology, Limnology, Municipal wastes, Dredging, Industrial wastes, Great

Detailed descriptions of water pollution of Lake Erie, strong recommendations for correction, and descriptions at the Lake, Lake basin, and the urban areas of the Lake Erie area are presented. Lake Erie and its drainage basin support over 13 million people. Manufacturing adds 17 billion dollars a year to the economy of the U. S. and Canada. The Lake water itself is used for water supply, recreation, commercial fishing, and shipping. The lake has too many nutrients from pollution. Bottom oxygen is depleted in summer. Fish quality is declining. Algae cause bad tastes and odor and litter shorelines with decomposing organic matter. Bac-terial contamination closes swimming beaches. Silt from channel dredging carries oxygen demand to dumping areas where it would otherwise be lower. The main pollution source areas are Detroit, Cleveland, and the Maumee River Basin. Phosphorus, the principal cause of algae problems, is 72% from municipal wastes, 17% rural, 7% industrial, and 7% urban runoff. The cost of waste treatment to stop the pollution is estimated at \$1.1 billion for mualities and \$285 million for industry. Standards for streams entering Lake Erie have been set. (Knapp-USGS) W69-02695

#### EFFECTS OF PESTICIDES ON FRESHWATER ORGANISMS,

Clemson Univ., Clemson. Dept. of Entomology and

John K. Reed, Lamar E. Priester, and Rudolph

Water Resources Institute, Technical Completion Report May 1, 1965 - June 30, 1968, 31 p, 4 tab. OWRR Project A-001-SC.

Descriptors: Algae, Protozoa, \*Aquatic insects, \*Aquatic drift, Fish food organisms, Fish physiology, Fish taxonomy, DDT, Phosphothioate pesticides, Herbicides, \*Pesticide residues, Diatoms, Crayfish, Pollutant identification, \*Water pollution effects, Gas chromatography.

Identifiers: South Carolina, Lyophilization, \*Pesticide metabolism, \*Pesticide accumulation.

Lists of arthropods, reptiles, amphibians and fish found in northwestern South Carolina streams by the authors are given. The ecology of these forms was affected by the presence of organic pesticide pollution in certain streams. The pollutants found were DDT, DDE, BHC, toxaphene, aldrin and dieldrin. The highest level of pesticide was in the organisms, then bottom mud with the least in water. Laboratory studies showed selected species of algae and protozoa concentrated DDT and parathion from water but breakdown products were not detectable. Trifluralin was both concentrated from water and metabolized by goldfish. Drifting food organisms of fish in the field were found to be influenced by the season of the year, weather, and pollution. W69-02782

#### DETERMINATION, **EVALUATION** AND ABATEMENT OF COLOR IN TEXTILE PLANT EFFLUENTS.

Georgia Inst. of Tech., Atlanta, Ga.

R. K. Flege.

Georgia Institute of Technology Water Resources Center, Report No. WRC-0868, Dec 1968. 68 p, 3 fig, 4 tab, 18 ref, 3 append. OWRR Project B-012-

Descriptors: \*Dye releases, \*Textiles, \*Textile waste effluents, Chromatography, \*Waste water treatment, \*Surfactants, Linear alkylate sulfonates, Biodegradation, Turbidity, Toxicity, \*Water quality control, \*Color, Foaming, Metabolism, Georgia, Dissolved oxygen, Oxidation lagoons, Industrial

Report is based on and summarizes data included in 4 M.S. theses: Forecasting Quantities of Dyestuffs and Auxiliary Chemicals Discharged into Georgia Streams by the Textile Industry, by L. G. Arnold: Color Evaluation in Effluents from Textile Dyeing and Finishing Processes, by W. S. Hood; The Degradability of Surfactants in Textile Mill Wastes with Hydrogen Peroxide, by D. N. Nonaka; and A Study of the Degradation of Some Azo Disperse Dyes in Waste Disposal Systems, by H. D. Pratt, Jr. Report finds, in part, that color in streams is a powerful index of the presence of pollutants; the presence or absence of color in streams is not an adequate criterion for evaluating the serious nature of pollution that results from receiving dyes and their companion colorless dye-like auxiliaries used for chemical control in dyeing processes; color in dyehouse waste may be significantly reduced by conventional waste treatment processes; that degradation of dyes in mill effluent in streams and treatment plants may result in metabolites that are more damaging to life processes than dyes; that some dyes are toxic to biota in activated sludge treatment plants; and that digestion of some dyes in conventional waste-treatment plants results in degradation products recognized to be carcinogenic. W69-02792

NITROGEN FIXATION AND THE UTILIZA-TION OF OTHER INORGANIC NITROGEN SOURCES IN A SUBARCTIC LAKE,

Alaska Univ., College, Inst. of Marine Science. For primary bibliographic entry see Field 02H. For abstract, see. W69-02795

## Field 05—WATER QUALITY MANAGEMENT AND PROTECTION

## **Group 5D—Waste Treatment Processes**

## 5D. Waste Treatment **Processes**

ELECTIVE DEDUCTION AND EXEMPTION FOR CONSTRUCTIONS OR IMPROVEMENT WASTE TREATMENT INDUSTRIAL FACILITIES.

Mass Ann Laws, ch 63 sec 38D (1967).

Descriptors: \*Massachusetts, Legislation, \*Taxes, \*Industrial wastes, Industrial plants, \*Treatment facilities, Water pollution control, Water quality, Waste treatment, Water treatment, Effluents. Identifiers: Tax advantages.

A deduction in determining net income subject to tax is allowed to any corporation for expenditures paid or incurred during the taxable year for construction or improvement of industrial waste treatment facilities. 'Industrial waste treatment facilities' and 'industrial waste' are defined. The deduction is allowed only for depreciable tangible property which is used in the trade or business of the tax payer and has a situs within the state. The facilities must be certified as complying with the water pollution control law by the Director of the Division of Water Pollution Control of the Department of Natural Resources. Provisions are made for corporations which begin to use their facilities for the salvage of by-products and which do not obtain a permanent certificate of compliance for such facilities. The deduction may not be used to compute the basis of the property upon sale or exchange thereof. Basis must be computed as if straight-line depreciation had been used. Facilities qualifying for the deduction are exempted from certain excise taxes. (Williams-Fla) W69-02461

#### THE OPTIMAL ALLOCATION OF STREAM DISSOLVED OXYGEN,

Johns Hopkins Univ., Baltimore, Md.; and Cornell

John S. Hopkins Olive, Battanian S. Hopkins Olive, Battanian S. Hopkins Olive, Battanian S. Lynn.
Jon C. Liebman, and Walter R. Lynn.
Water Resources Research, Vol 2, No 3, pp 581-591, Third Quarter 1966. 11 p, 5 fig, 5 tab, 11 ref.

Descriptors: \*Dissolved oxygen, Effluents, Dynamic programming, Costs, Waste treatment, Streams, Water quality, River basins, Linear programming, Biochemical oxygen demand, Streamflow. Identifiers: \*Optimal allocation, Willamette River, Stream studyed, Effluent streamflow, Consentation, 1987.

Stream standard, Effluent standard, Concentration

A dynamic programming model that minimizes the cost of providing waste treatment to meet specified dissolved oxygen concentration standards in a stream is developed. The model is solved for a simplified example based on data from the Willamette River. Implications of the model on policy formulation are discussed. (Seneca-Rutgers)

## CONTROL OF MINE DRAINAGE WATER,

Pennsylvania State Univ., University Park For primary bibliographic entry see Field 05G. For abstract, see . W69-02539

## DYNAMIC ECONOMIC EFFICIENCY WATER QUALITY STANDARDS CHARGES,

CHARGES, Washington Univ., Seattle. Gardner Brown, Jr., and Brian Mar. Water Resources Research, Vol 4, No 6, pp 1153-1159, December 1968. 7 p, 8 fig, 6 ref.

Descriptors: \*Water quality, \*Economic efficiency, Water pollution, Waste treatment, Administration, Effluents, Standards.
Identifiers: \*Demand function, \*Damage function, \*Waste discharge function, Water quality charges, Stream standards.

Stream standards.

If a manager of a given water resource is uncertain of his power to set optimum stream standards or optimum effluent charges at every moment in time, there exist conditions, qualitatively identified, under which it may be dynamically more efficient for him to establish present water quality levels that will be optimum only at some future date than to try unsuccessfully to achieve optimum levels at every point in time. Excess demand functions and an aggregate nonlinear damage function are the conceptual underpinnings of this paper. (Seneca-Rutgers) W69-02549

#### AMORTIZING WASTE TREATMENT FACILI-TIES.

N C Gen Stat sec 105-130, 10 (1967 Supp).

Descriptors: \*North Carolina, Legislation, Legal aspects, Administrative agencies, Local governments, \*Taxes, \*Depreciation, \*Amortization, Sewage systems, Treatment facilities, Water pollution, Pollution abatement, Permits.

Identifiers: Board of water and air resources.

At the option of the corporation, in lieu of any depreciation allowance, a deduction shall be allowed for amortization of the cost of any sewage or lowed for amortization of the cost of any sewage of waste treatment plant, including waste lagoons and pollution abatement equipment, which reduces the amount of water pollution resulting from the discharge of sewage and industrial wastes, based on a period of 60 months. The procedures for obtaining this allowance are stated. (Childs-Florida) W69-02705

## TAX EXEMPTION OF REAL PROPERTY USED FOR AIR OR WATER POLLUTION ABATE-MENT FACILITIES.

N C Gen Stat sec 105-296 (11) (1964).

Descriptors: \*North Carolina, \*Legislation, Administrative agencies, Local governments, \*Taxes, \*Treatment facilities, Real property, Water pollution, Permits, Pollution abatement. Identifiers: Tax exemption.

Real property, or that part which is used exclusively for air cleaning or waste disposal or air or water pollution abatement facilities, including waste lagoons, is exempt from taxation. The procedures for obtaining this exemption are provided by the statute. (Childs-Florida)
W69-02706

## TAX EXEMPTION OF REAL PROPERTY USED FOR AIR OR WATER POLLUTION ABATE-MENT FACILITIES.

N C Gen Stat sec 105-296 (11) (1967 Supp).

Descriptors: \*North Carolina, Legislation, Legal aspects, Administrative agencies, Local governments, \*Taxes, Treatment facilities, \*Real property, Air pollution, Water pollution, Pollution abatement, Permits.

Identifiers: Tax exemption.

Real property, or that part which is used exclusively for air cleaning or waste disposal or air or water pollution abatement facilities, including waste lagoons, is exempt from taxation. The procedures for obtaining this exemption are provided. (Childs-Florida) W69-02707

## WATER AND SEWER SANITATION.

N C Gen Stat sec 130-161, 130-165 (1967 Supp).

Descriptors: \*North Carolina, Legislation, Administrative agencies, \*Regulation, \*Environmental sanitation, \*Sewage treatment, Water supply, Municipalities, Drainage, Sewers, Water purification, Surveys, Military reservations.

Identifiers: State Board of Health.

The State Board of Health is to advise and consult with those having, or intending to introduce, systems of water supply, drainage, or sewerage, or intending to make major alterations of such systems, so as to ascertain the most appropriate source of supply, the best method of assuring the purity thereof, and the most advantageous means of disposing of their drainage or sewerage. No introduction or alteration of a system will be allowed until the State Board of Health has approved the project. The act prohibits the discharge of sewage or industrial waste above the intake into any source from which a public drinking water supply is taken unless such waste has been passed through some approved system of purification. (Childs-Florida)

## 5E. Ultimate Disposal of Wastes

PROGRESS IN THE UNITED STATES OF AMERICA TOWARD DEEP-WELL DISPOSAL
OF LIQUID AND GASEOUS RADIOACTIVE WASTES.

Geological Survey, Washington, D. C. A. Clebsch, Jr., and E. H. Baltz. Symp on Int At Energy Agency, Vienna, and Europe Nucl Energy Agency, May 29-June 2, 1967, pp 591-605, 1967. 15 p, 33 ref.

Descriptors: \*Injection wells, \*Radioactive waste disposal, United States, Observation wells, Pumping, Safety, Water quality, Aquifers, Aquicludes, Aquifer characteristics, Mathematical models. Identifiers: Waste gas injection.

The basic technology for deepwell disposal of liquid wastes developed and used by the petroleum industry and adapted by the chemical industry is discussed. Requirements for disposal of radioactive wastes include an understanding of physical and geologic characteristics of the disposal reservoir, effects of chemical reactions between waste and reservoir rock, and hydraulic effects of long-term injection on rate and direction of mass transport and integrity of geologic units bounding the disposal reservoir. Deep-well disposal is not feasible at many existing waste-generating sites because of unsuitable geologic environments. Gas injection research concerns rapid disposal of relatively large volumes of fission-products into water-saturated or unsaturated rocks. Mathematical models of gas flow, definition of the problems of dispersion, laboratory studies of gas sorption on earth materials, the role of barometric changes in bringing injected gases back into the atmosphere, engineering and economic evaluations, and field tests of the method have all been studied. As a safeguard for the rapid disposal of fiscing product gases and the rapid disposal of fission-product gases and other gases after major reactor accident, the injec-tion method is severely limited in saturated rocks by dependence on favorable hydrogeologic conditions, the need to prepare the disposal reservoir in advance and maintain it by continuous injection of air, and the cost. The prospects are better for using the method in unsaturated rocks and for routine disposal of waste gases that can be separated as a low-volume stream. (Knapp-USGS) W69-02688

SCIENTIFIC PREREQUISITES FOR UTILIZING DEEP-LYING FORMATIONS FOR BURYING LIQUID RADIOACTIVE WASTES, Akademiya Nauk SSSR, Moscow. Institut Fizicheskoi Khimii.
V. I. Spitsyn, M. K. Pimenov and F. P. Yudin. Proc of Symp, Int At Energy Agency, Vienna, and Europe Nucl Energy Agency, May 29-June 2, 1967, pp 563-576, 1967. 14 p, 2 fig, Discuss.

Descriptors: \*Injection wells, \*Radioactive waste disposal, Observation wells, Pumping, Safety, Water quality, Aquifers, Aquicludes, Aquifer characteristics.

The Soviet Union is pursuing several lines of research on disposal of liquid radioactive wastes,

including the injection of wastes into deep geological formations. The use of porous water-bearing strata in the earth's crust far enough below the surface and isolated above and below by thick strata of species that are impermeable to water is considered. The main features and methods of hydrogeological surveying and the various research projects that are necessary to ensure health and radiation safety are described, and a number of questions relating to the physico-chemical processes which occur in absorbing strata when radioactive waste is injected into them are considered. The processes discussed include migration. radiolysis, evolution of gas and heating of the surrounding medium. It is shown that, under particular geological conditions, deep burial of radioactive waste affords a promising means of disposal that ensures health and radiation safety and is at the same time economically advantageous. It is also demonstrated that the waste is distributed over a limited area of the stratum, which involves no serious changes in the hydrogeological pattern of the region and so does not prevent the formation from being used for other purposes. (Knapp-USGS) W69-02692

## **EXEMPTION FROM TAXATION OF TREAT-MENT FACILITIES.**

N C Gen Stat sec 105-297 (16) (1964).

Descriptors: \*North Carolina, Legislation, Administrative agencies, Regulation, Local governments, \*Taxes, Sewage, Wastes, \*Treatment facilities, Permits, \*Pollution abatement. Identifiers: Tax exemption.

Sewage and waste treatment facilities, and water pollution abatement equipment designed to abate or reduce water pollution are exempt from taxation. The procedures for obtaining this exemption are described. (Childs-Florida) W69-02703

## 5F. Water Treatment and **Quality Alteration**

ACQUISITION OF ADDITIONAL WATER RIGHTS - ENLARGEMENTS, PURIFICATION

NY Village Law sec 225 (McKinney 1966).

Descriptors: \*New York, \*Legislation, Water law, Administrative agencies, Cities, Water rights, Water sources, \*Water supply, Water storage, Reservoirs, Water purification, Water treatment, \*Water works, Legal aspects.

The board of trustees of a village may, by resolution, determine to purchase or acquire additional water or water rights, construct or add to a water purification or treatment plant, construct additional reservoirs, or otherwise increase the system of water for the village. The resolution must state the maximum sum to be appropriated. The board has the same power and duties regarding the new construction as it possessed in the construction of the original system of water works. (Watson-Florida) W69-02697

## TRANSPORT OF ELECTROLYTES THROUGH MEMBRANE SYSTEMS,

Southern Research Inst., Birmingham, Ala.

Robert E. Lacey.
Office of Saline Water Research and Development Progress Report No. 343, March, 1968. 101 p. OSW-14-01-0001-464.

Descriptors: \*Ion transport, \*Electrodialysis, \*Permselective membranes, Diffusion, Osmosis, Electroosmosis, Transport depletion, Semipermeable membranes, Demineralization, Theoretical analysis, Membrane processes.

Identifiers: \*Irreversible thermodynamics, Admittance coefficients, Membrane synthesis, Water

Experimental methods were developed to measure with acceptable accuracy six independent transport characteristics that are needed to describe the transport of ions and water through membrane systems. The experimentally determined values of the six transport characteristics were used to calculate the admittance coefficients for the classical phenomenological equations for membrane transport systems. Seven-cellulosic membranes were studied, and the effects of changes in solution concentration on the admittance coefficients and the friction factors were determined for four of them. In addition, the effects of changes in current density of the admittance coefficients were determined for these four membranes. The admittance coefficients and friction factors determined with the aid of the new techniques were used to calculate for specific demineralization situations the portions of the total flux of ions and water that result from individual driving forces (e.g., diffusive, osmotic, and electro-osmotic fluxes), and the degrees of interaction between moving species. It was demonstrated that the fluxes and interactions, so calculated, can show the sources of discrepancies between actual demineralization performance and performance predicted by the methods in use prior to the present research. In addition to the major efforts described above, brief studies were made of two new methods of preparing ion-selective membranes. (Scott-OSW) W69-02783

## EFFECTS OF ARTIFICIAL FERTILIZATION ON PLANKTON AND BENTHOS ABUNDANCE IN FOUR EXPERIMENTAL PONDS,

Oregon State Univ., Corvallis. Dept. of Fish and

Game Management.
David C. McIntire, and Carl E. Bond.
Trans Amer Fish Soc, Vol 91, pp 303-312, 1962. 10 p, 6 fig, 6 tab, 9 ref.

Descriptors: \*Eutrophication, \*Fertilization, \*Fish food organisms, \*Bioindicators, Crustaceans, Rotifers, Diatoms, Midges, Dragonflies, Ponds, Water quality, Water pollution effects, Nutrients, Plankton, Benthos, Chlamydomonas, Phosphorus, Nitrogen.

Identifiers: Lepomis, Micropterus, Bosmina, Cyclops, Chydorus, Diaphanosoma, Polyarthra, Keratella, Brachionus, Conochilus, Asplanchna, Closterium, Cosmarium, Eudorina, Micractinium, Pandorina, Staurastrum, Phacus, Trachelomonas, Dinobryon, Gymnodinium, Cryptomonas, Oedogonium, Gordius, Cryptophyceae, Desmids.

Before fertilization, four experimental ponds near Corvallis, Oregon, were characterized by low concentrations of nitrogen and phosphorus, pH values near neutrality, low total alkalinities, and nearly saturated concentrations of dissolved oxygen.
Monthly from March to October 1959, ponds were treated as follows: Pond 1 received no fertilizer; Pond 2 received 16.7 pounds of urea (as source of nitrogen); Pond 3, 16.7 pounds of urea and 25.0 pounds of single super phosphate; and Pond 4, 33.4 pounds of urea and 50.0 pounds of single super phosphate. In fertilized ponds, chemical and physical conditions were altered considerably, and large populations of phytoplankton and zooplankton were produced. Benthic communities developed after the establishment of planktonic populations, especially in two ponds receiving nitrogen and phosphorus. The benthic community developed most rapidly, and with greatest biomass, in the pond receiving heaviest application of both fertilizers. Benthic production was low in ponds which received no phosphorus. Concentrations of dissolved oxygen remained near saturation for unfertilized pond, but fertilized ponds were characterized at some time by reduction of oxygen due to decomposition of planktonic organisms.

W69-02788

## 5G. Water Quality Control

WATER AND WATER RIGHTS - WATER POL-LUTION AND QUALITY CONTROLS.

Burton J. Gindler.

Clark, Waters and Water Rights, Vol 3 - Water Pollution and Quality Controls, 1967, 540 p.

Descriptors: \*Water pollution, \*Water quality, \*Riparian rights, Water rights, Invasion, Remedies, Damages, \*Legislation, Legal aspects, Federal government, Administrative agencies, Abatement, Standards, Mexican water treaty, Rivers and harbors act, Jurisdiction, State governments.

Identifiers: FWPC Act, Injunction, Defenses, Oil pollution act.

This volume contains chapters 12-15. Chapter 12 deals with the problems and solutions of water quality controls. It discusses physical and chemical properties affecting water quality, natural quality of water, sources and means of water pollution, evaluation of water quality, and the history of water quality control laws. Chapter 13 deals with water quality controls enforceable under state law. Chapter 14 covers state administrative regulation of water quality. Chapter 15 examines water quality control in federal jurisdictions with emphasis on the Federal Water Pollution Control Act of 1948. (Watson-Fla) W69-02414

## ASSISTANCE RENDERED UNDER THE FWPC

Burton J. Gindler.

Clark, Waters and Water Rights, Vol 3, Water Pollution and Quality Controls, Chapter 15, Sec 249, pp 404-408, 1967, 5 p.

Descriptors: Water quality, \*Water pollution, \*Federal government, \*Legislation, Administrative agencies, Abatement, Reservoir construction, Watersheds (Basins), Wastes, \*Financing, Grants, Taxes, Sewage treatment. Identifiers: FWPC Act.

The FWPC Act provides both financial and technical assistance. The primary financial incentive provisions of the act are in sections 3, 5-8, and 18. Section 3 (b) (4) provides that when the water quality control features incorporated in any federal reservoir provide benefits that are widespread or national in scope, the costs of such features shall be nonreimbursable. Section 3 (c) authorizes the Secretary to make a grant of up to 50% of the administrative expenses of a planning agency, for a period up to three years, for the development by that agency of a comprehensive pollution control and abatement program for a basin. Section 5 (a) (2) authorizes the Secretary to make grants-in-aid for research or training projects and for demonstra-tions. Section 6-8 provide grants for research, training of personnel, and construction of treatment plants for the control of waste. Section 18 directs the Secretary to use financial stimulae, including tax incentives, to promote the construction of waste-treatment facilities. The Act has many provisions to provide technical assistance for studies and research in the area of water quality and pollution control. (Watson-Fla) W69-02415

## ENFORCEMENT PROCEEDINGS UNDER THE FEDERAL WATER POLLUTION CONTROL

Burton J. Gindler.

Clark, Waters and Water Rights, Vol 3, Water Pollution and Quality Controls, Chapter 15, Sec 248, pp 381-404, 1967. 24 p.

Descriptors: Water quality, \*Water pollution, Federal government, \*Legislation, Administrative agencies, \*Abatement, Navigable waters, Interstate rivers, Jurisdiction, \*Standards, Conferences. Identifiers: FWPC Act.

## Field 05-WATER QUALITY MANAGEMENT AND PROTECTION

## Group 5G-Water Quality Control

Section 10 of the FWPC Act contains provisions for administrative regulation and enforcement proceedings and for judicial enforcement proceedings in regard to water quality and pollution control. Two types of proceedings are availa-ble: (1) water pollution abatement proceedings, which have been in the act since its enactment in 1948; and (2) water quality standards proceedings, which were added to the act in 1965. Pollution abatement consists of three stages of enforcement procedures: (1) Conference, (2) Public hearing, and (3) Court action. Pollution abatement proceedings may be used against the pollution of any navigable wa'ze, whether interstate or intrastate. The water quality standards proceedings consist of three stages -- (1) establishment or revision of standards, (2) informal hearing, and (3) court action. In regard to interstate waters for which water quality standards have not yet been established, only the water pollution abatement procedures are available. Water quality standards are applicable only to interstate waters. (Watson-W69-02416

ADMINISTRATIVE AGENCIES - JURISDICTION - UNDER THE FEDERAL WATER POL-LUTION CONTROL ACT,

Burton J. Gindler.

Clark, Waters and Water Rights, Vol 3, Water Pollution and Quality controls, Chapter 15, Sec 246-247, pp 364-381, 1967. 18 p.

Descriptors: Water quality, \*Water pollution, \*Federal government, \*Legislation, Administrative agencies, Abatement, Navigable waters, Interstate rivers, \*Jurisdiction. Identifiers: FWPC Act.

The FWPC Act is implemented through the FWPC Administration which is in the Department of the Interior. Activities undertaken pursuant to the FWPC Act may affect various water sources in the United States, depending upon the nature, purpose, and source of initiation of the particular activity involved. There appears to be little, if any, limitation on the waters that may be considered under the technical or financial provisions of the act. The water-quality standards of the act apply only to in-terstate waters. However, the pollution abatement provisions apply to all navigable waters whether in-terstate or intrastate. The basic purposes of the FWPC Act are to enhance water quality and to establish a national policy of water pollution control. What is considered water pollution, however, varies according to which provisions of the act are being applied. For the purpose of administrative or judicial enforcement, the term water pollution is somewhat more restricted than the meaning given to that term for study or financing purposes. (Watson-Fla) W69-02417

THE FEDERAL WATER POLLUTION CONTROL ACT OF 1948 - INTRODUCTION, Burton J. Gindler.

Clark, Waters and Water Rights, Vol 3, Water Pollution and Quality Controls, Chapter 15, Sec 245, pp 359-364, 1967. 6 p.

Descriptors: Water quality, \*Water pollution, \*Federal government, \*Legislation, \*Administrative agencies, Navigable waters, Abatement, Interstate rivers Identifiers: FWPC Act.

The FWPC Act is the most important federal The FWIC Act is the most important recent statute dealing with water quality and water pollu-tion. The stated congressional purpose of the act is to enhance the quality and value of our water resources and to establish a national policy for water pollution control. The act recognizes the primary responsibilities and rights of the states in this field and establishes the policy of providing techni-cal and federal aid to states, interstate agencies, and municipalities. The act provides tools for attacking water pollution and for preserving and enhancing water quality. Administrative and judicial enforcement procedures, with primary emphasis on voluntary compliance during the administrative phases are established, and co-operation with and among federal agencies is encouraged. Studies, reports, investigations, demonstrations, and other forms of technical assistance are provided to identify pollution and to pinpoint a means of pollution control. (Watson-Fla) W69-02418

GENERAL FEDERAL LEGISLATION RELATING TO WATER QUALITY,

Burton J. Gindler.

Clark, Waters and Water Rights, Vol 3, Water Pollution and Quality Controls, Chapter 15, Sec 244, pp 354-358, 1967. 4 p.

Descriptors: \*Water quality, \*Federal government, Oil, Water pollution, \*Legislation, Navigable waters, \*Rivers and Harbors Act, Channel, Wastes, Lake Michigan.

Identifiers: Oil pollution act, California Debris Commission Act, FWPC Act.

The United States has enacted more than a dozen statutes that deal piecemeal with water quality and pollution control. The primary purpose of the earliest statutes was to protect and promote the navigability of the waters of the United States. The Rivers and Harbors Act of 1899, which is perhaps the most important of the early federal pollution control laws, prohibits the creation of any obstruction in navigable waters of the United States unless such is authorized by Congress. It also prohibits changing the channel of any navigable water unless the work is authorized by the Corps of Army Engineers, and section 13 makes it unlawful to discharge refuse of any kind or description, other than that flowing from streets and sewers and passing therefrom in a liquid state, into any navigable water of the United States. Some federal statutes relate to specific waters. Others that are more limited in scope relate to specific kinds of refuse or wastes. The best known of these is the Oil Pollution Act of 1924. The public-health aspects of water pollution have been handled under the Public Health Service Act. (Watson-Fla) W69-02419

INTERNATIONAL LAW, TREATIES, AND WATER QUALITY, Burton J. Gindler.

Clark, Waters and Water Rights, Vol 3, Water Pollution and Quality Controls, Chapter 15, Sec 243, pp 348-354, 1967. 7 p.

Descriptors: \*Water quality, \*International law, Federal government, International waters, \*Treaties, Mexico, International commissions, Water pollution, Oil, Radioactive wastes, United Nations, \*Mexican water treaty, Colorado River Basin, Colorado River.

Identifiers: Thermonuclear testing, Oil pollution

Pollution of the waters of the high seas, of inland waters of the United States, and of international drainage basins may be the subject of international law, including the provisions of multilateral and bilateral treaties entered into by the United States. International agreements have dealt with pollution of the high seas with oil, radioactive waste, and products of thermonuclear testing. Oil pollution from vessels is covered by the International Convention for the Prevention of the Pollution of the Sea by Oil, 1954. The United States is a party to the Convention and has implemented its provisions by the Oil Pollution Act of 1961. The United Nations Convention of the High Seas, to which the United States is a party, provides for the prevention of oil pollution and waste from radioactive substances and thermonuclear testing. Pollution problems with an international aspect may also result from pollu-tion by foreign nations of inland waters of the United States. There is yet any multilateral convention or treaty relating to the pollution of waters of international basins, but the United States has individual treaties with both Canada and Mexico. (Watson-Fla) W69-02420

INTERSTATE COMPACTS AND WATER QUALITY, Burton J. Gindler.

Clark, Waters and Water Rights, Vol 3, Water Pollution and Quality Controls, Chapter 15, Sec 242, pp 332-348, 1967. 17 p.

Descriptors: Water pollution, \*Water quality, Administrative agencies, Standards, Effluents, Industrial wastes, Wastes, Pollutants, Legislation, Taxes, \*\*Interstate compacts, \*Interstate rivers, \*River basin commissions, Colorado River, Delaware River Basin Commission. Identifiers: SWPC Act.

Rights to permit or to prohibit degradation of water quality may be involved directly or indirectly in interstate compacts. An interstate compact may expressly disclaim any attempt to deal with water quality or pollution problems. States have agreed upon, and Congress has consented to, ten interstate compacts that deal directly with administrative controls for water quality and pollution. All of these compacts provide for an interstate commission or agency, with representatives from the states and in some cases also from the United States, to administer their provisions. The jurisdiction of an interstate commission is limited to waters in the interstate drainage basin with which the particular compact is concerned. Most of the compacts recognize expressly that no single standards of water quality could practicably be made applicable to all waters under the jurisdiction of their commissions. Most of the compacts provide that they are not intended to preclude any signatory state from imposing any additional conditions or restrictions to further lessen or prevent the pollution of waters within its jurisdiction. (Watson-Fla) W69-02421

JUDICIAL REVIEW OF ACTIONS BY THE STATE WATER QUALITY AND POLLUTION CONTROL AGENCY,

Burton J. Gindler.

Clark, Waters and Water Rights, Vol 3, Water Pollution and Quality Controls, Chapter 14, Sec 231, pp 273-293, 1967. 20 p.

Descriptors: Water pollution, \*Water quality, Standards, \*Administrative agencies, Effluents, Wastes, Pollutants, Legislation, \*Judicial decisions, Remedies, Sewage, \*Abatement. Identifiers: Judicial review, SWPC Act, Injunction.

Effluent or receiving-water standards established by the agency may be challenged in judicial proceedings either because they are too strict or are not strict enough. Appeal from an administrative order may be inappropriate because the particular issues raised are not yet ripe for judicial review. Also, the plaintiff cannot secure judicial review of a determination until he has exhausted his administrative remedies. Any person aggrieved or adversely affected by administrative action has standing to seek judicial review. The agency seek injunctive relief against any person violating provisions of the act or an administrative order. In jurisdictions which provide for appeal from the agency's orders, collateral attack on an administrative determination is not permitted. The doctrine of primary jurisdiction does not relate to direct judicial review of administrative action. Administrative actions and water quality and pollution control statutes have been challenged on constitutional grounds. Almost uniformly, these constitutional challenges have failed. (Watson-Fla) W69-02422

REMEDIES FOR ENFORCEMENT BY THE STATE WATER QUALITY AND POLLUTION CONTROL AGENCY, Burton J. Gindler.

Clark, Waters and Water Rights, Vol 3, Water Polution and Quality Controls, Chapter 14, Sec 230, pp 267-273, 1967. 7 p.

Descriptors: \*Water pollution, Water quality, \*Standards, \*Administrative agencies, Effluents, Wastes, Pollutants, Legislation, \*Remedies,

Identifiers: SWPC Act.

Public officials have the privilege of entering private property to avert an imminent public disaster, to abate a public nuisance, or to perform such other duty or exercise such other authority as may be imposed or created by statute. These privileges permit the summary abatement, without notice or hearing, of water pollution requiring immediate action, eg, where the pollution constitutes an immediate and direct threat to public health. Most alleged violations will be attacked by the board by way of an order after notice and hearing. In issuing such orders, the board can take into ac count not only the remedial action required but also the timing for such action in light of all the circumstances. In order to determine whether violations are taking place, or even to convince itself that they are not, the board should be authorized to require technical reports and to examine other pollution. State laws generally provide that viola-tion of the statute regulations or orders is a misdemeanor. (Watson-Fla)

### ADMINISTRATIVE POWERS OF THE STATE WATER QUALITY AND POLLUTION CON-TROL AGENCY,

Burton J. Gindler.

Clark, Waters and Water Rights, Vol 3, Water Pollution and Quality Controls, Chapter 14, Sec 229, pp 230-267, 1967. 37 p, 1 tab.

Descriptors: Water pollution, \*Water quality, \*Administrative agencies, \*Standards, Effluents, Industrial wastes, Wastes, Pollutants, Legislation, \*Taxes.

Identifiers: Receiving waters, SWPC Act.

The traditional approach to water quality and pollution control by a state administrative agency has been to specify the characteristics of the effluent being discharged into state waters or the conditions to be maintained in the receiving waters. Most commonly; some combination of the above methods is used. Establishment and implementation of these standards is usually on a case-by-case pasis. Thus, the standards may vary from one body of water to another. In general, the system of clas-sification designates the beneficial uses to be protected and the water quality required to provide such protection. Although the classification will consist primarily of receiving-water standards, it will often provide some effluent standards; it may also include the degree of treatment required for the waters, eg, removal of natural impurities. Financial incentives such as an income tax deduction or an exemption of water quality facilities from ad valorem property taxes are used in addition to lechnological advice. (Watson-Fla) W69-02424

# DRGANIZATION AND JURISDICTION OF THE STATE WATER QUALITY AND POLLUTION CONTROL AGENCY,

Burton J. Gindler.

Clark, Waters and Water Rights, Vol 3, Water Polution and Quality Controls, Chapter 14, sec 227-228, pp 205-230, 1967. 25p

Descriptors: \*Water pollution, \*Water quality wastes, Streams, Sewage, Legislation, \*Administration, Administrative agencies. dentifiers: SWPC Act.

Discarding old systems whereby authority was frag-nented among many different agencies, most states have vested responsibility for pollution control and

for over-all coordination and regulation of water quality in a state administrative board composed of representatives of the affected interests. Usually an Executive Secretary administers and enforces the board's decisions. A recent trend is to place the board in an agency with more than merely water quality and pollution control responsibilitieseither a water resources agency or an agency which deals with a number of environmental quality problems, eg, air pollution. The jurisdiction of the water quality and pollution control agency should be broad, covering all the waters within the state and all persons whose activities may affect the quality of the waters of the state. (Watson-Fla)

#### WATER POLLUTION AS A PUBLIC OFFENSE,

Clark, Waters and Water Rights, Vol 3, Water Pollution and Quality Controls, Chapter 13, sec 220, pp 190-196, 1967. 7 p.

Descriptors: \*Water pollution, Water rights, Reasonable use, Invasion, Riparian rights, Remedies, \*Damages, Competing uses, \*Legislation, Easements, Prescriptive rights, Legal aspects, Ludicial deprints

Identifiers: Injunction, Defenses.

Water pollution may constitute a public offense against the state, commonly called a public nuisance. Although it is punishable as a crime, a public nuisance can be attacked in civil proceedings by public authorities and by a private party if he can show that the pollution constitutes a private nuisance. A public nuisance may be caused by water pollution in three different ways: (1) it may affect a large number of persons; (2) it may affect a public resource; or (3) it may be unlawful by statute. If water pollution is made a criminal offense, such offense is usually denominated a misdemeanor and may be punishable by fine or im-prisonment. Two civil remedies are also generally available against a public nuisance caused by water available against a public nuisance caused by water pollution. These are: (1) a suit in the name of the state to enjoin the pollution; and (2) a public official may enter upon the polluter's land to abate the public nuisance. Generally speaking, the defenses which may be asserted in actions against private nuisances are not valid in an action against a public nuisance. It is universally held that no prescriptive right can be obtained to maintain a public nuisance. (Watson-Fla)
W69-02426

#### INTERGOVERNMENTAL UNDER THE FWPC ACT, RELATIONSHIPS

Burton J. Gindler. Clark, Waters and Water Rights, Vol 3, Water Pol-lution and Quality Controls, Chapter 15, sec 250, pp 408-410, 1967. 3 p.

Descriptors: Water quality, Water pllution, \*Federal government, \*Legislation, Administrative agencies, Abatement, Standards, \*Jurisdiction, Oil, Canada, Rivers and Harbors Act, Mexican Water

Treaty, \*State governments.
Identifiers: FWPC Act, Public health service,
Boundary waters treaty, Oil pollution act.

The FWPC Act contains a number of disclaimers. For example, it does not supplant other water quality and pollution control devices at other levels quality and pollution control devices at other levels of government. State and interstate action is encouraged, and other federal remedies are preserved. Section 1 (c) declares the policy of the act to be nonimpairment of any right or jurisdiction of the states with respect to their waters, including boundary waters. Section 10 (b) provides that state and interstate action to abate pollution of interstate or navigable waters is encouraged and is not displaced by federal enforcement action, except as may be provided by court order. Section 14, deal-ing with federal laws, provides that the act shall not be construed to supercede or limit the functions of the Surgeon General, Public Health Service, or any other agency of the United States concerned with water pollution. (Watson-Fla) W69-02427

#### **BUMBARGER V WALKER (CONTAMINATION** OF PERCOLATING WATERS).

193 Pa Super 301, 164 A 2d 144-151 (Super Ct Pa

Descriptors: \*Judicial decisions, \*Strip mine wastes, Domestic water, Taste, \*Acid mine water, Fouling, Mine drainage, \*Explosives, \*Percolating water, Damages, Pennsylvania, Legal aspects.

Plaintiffs sought damages for the ruination of the quality of their spring water caused by sulfur-water intrusion from defendants' strip mining operations. The defendants' mine was on higher elevation than the spring, and the defendants engaged in heavy blasting and drilling in an effort to remove excess water from the mine. The jury found that this blasting could have altered the flow of subsurface waters, thereby rendering the water percolating into the spring unfit for domestic use. On appeal, the defendants contended that they could not be held liable for the damage to the spring, absent a showing of malice or negligence by the plaintiffs. The appellate court affirmed the jury's determination, saying that by damaging the plaintiffs' spring through their blasting operation, defendants were prima facie liable. The court determined that a mere showing that blasting was less expensive than pumping the excess water in a direction away from the spring offered no excuse for damaging another's property. The measure of damages, if permanent, was the difference in market value of the land before and after the injury, or the cost of removing the obstruction, whichever was lower. (Blunt-Fla) W69-02450

## UNITED STATES V REPUBLIC STEEL COR-PORATION (INDUSTRIAL WASTES). 286 F 2d 875-891 (1961).

Descriptors: Rivers and Harbors Act, \*Industrial wastes, Industrial water, Cooling water, Industrial plants, Dissolved solids, \*Waste disposal, River beds, \*Navigable rivers, \*Channels, Federal government, Legislation, Judicial decisions, \*Il-

Identifiers: Columet River, Flue dust.

The United States instituted suit to enjoin three iron and steel fabricators located along the Coluiron and steel fabricators located along the Columet River from depositing industrial solids in a navigable river and asked that defendants be required to restore the depth of the channel. The suit was based on violation of sections 10 and 13 of the Rivers and Harbors Act. The United States District Court for the Northern District of Illinois found for the United States. The judgment was reversed by the appellate court but affirmed by the United States Supreme Court. On remand, the court affirmed the greating of the preliminary in United States Supreme Court. On remand, the court affirmed the granting of the preliminary injunction by the Court of Appeals, finding, however, that there was no substantial evidence to support the factual determination of trial court that the 3 defendants were responsible for not less than 81 1/2% of the industrial solids found in the channel, and that there was no substantial evidence to support the finding regarding percentage of responsi-bility of the several defendants for such deposits. The case was remanded to the trial court for a new trial as to the demand of the United States that defendants restore the channel to its original depth of 21 feet. (Carruthers-Fla)
W69-02457

## RIGHTS OF WAY FOR MINING, QUARRING,

83 Ga Code Ann sec 83-201--209 (1967).

Descriptors: \*Georgia, Legislation, \*Right-of-way, Rivers, Watercourses (Legal), \*Mining, Mine water, Mine wastes, Withdrawal, \*Consumptive use, Surplus water, Diversion, Diversion structures.

## Field 05—WATER QUALITY MANAGEMENT AND PROTECTION

### **Group 5G—Water Quality Control**

Any person, corporation, or company which is actually engaged in mining and finds it necessary to obtain a right-of-way for any purpose over the lands of another in order to carry out such mining shall obtain such right-of-way in the manner prescribed for acquiring the right to convey water over the lands of another. Arbitrators may be selected where there is disagreement as to the necessity of the right-of-way or the compensation therefor. Arbitration is authorized to settle questions surrounding the diversion of watercour-ses. Upon payment of damages, the owner of any mine shall have the right to enter any land between it and the water source upon which the mine de-pends for the purpose of constructing ditches, flumes, or dams. The owner of such land is to be given notice. Only surplus water may be diverted entirely from streams. Procedures for the application for rights-of-way and the assessment of damages are set out. Lessees of mines are to be treated as owners under this act. (Williams-Fla) W69-02459

#### AN ACT CONCERNING THE ELIMINATION OF POLLUTION OF THE WATERS OF THE

1967 Laws of Connecticut, Pub Act No 57, sec 1-6.

Descriptors: \*Connecticut, \*Legislation, Water pollution, \*Water pollution control, Public health, Taxes, Water temperature, Sewage, Cities, Bodies of water, Pollution abatement, Federal government, Waste treatment, \*Water quality control,

Administrative agencies.
Identifiers: Fed Water Pollution Control Act, Connecticut Water Resources Comm.

The Connecticut legislature, in declaring pollution of state waters a public nuisance, inimical to public health, harmful to wildlife, and an impairment of agricultural, industrial, and other beneficial uses of such waters, has deemed the control and elimination of such pollution a public use and purpose for which public monies may be expended and tax ex-emptions granted. A Water Resources Commission was established to administer and enforce the Act. The terms of the act, including wastes, pollution, harmful thermal effect, and discharge were defined. Water was broadly construed to encompass tidal waters, harbors, drainage systems, and all accumulations of water, public or private, which are contained in, flow through, or border on the state. The commission has numerous specific powers, eg, the power to issue orders prohibiting pollution, the power to convene hearings and to subpoena witnesses and evidence, and the power to approve construction of pollution abatement facilities. It shall adopt water quality standards consistent with the Federal Water Pollution Control Act. However, public hearings must be conducted prior to the adoption or amendment of such standards. (Geraghty-Fla) W69-02462

## AN ACT CONCERNING THE ELIMINATION OF POLLUTION OF THE WATERS OF THE

1967 Laws of Connecticut, Pub Act No 57, sec 7-

Descriptors: \*Connecticut, Legislation, Cities, \*Permits, \*Pollution abatement, Water pollution, Treatment facilities, Construction costs, Water quality, \*Taxes, Local governments, Remedies. Identifiers: FWPCA.

If the commission finds that any municipality is causing pollution of state waters, it shall issue an order to abate pollution. The order shall include a time table for action and a list of steps to be taken. Similar orders shall be issued to any person causing pollution of state waters. After the effective date of the act, no person shall create or originate any new discharge of water, substance, or material into the state's waters without a person form the control of the control state's waters without a permit from the Commission. Sources of discharge operating under such permits shall be periodically investigated by the Commission. Any person or municipality failing to comply with a pollution abatement order shall be enjoined until such time as the order has been fully complied with. A knowing violation of the Act is subject to a fine as fixed by the court. The Commission shall make grants to any municipality for the construction or expansion of pollution abatement facilities in accordance with the provisions of the Act. Specific sections of the Act provide for tax credits or deductions to individuals for the construction or improvement of pollution abatement facilities. (Geraghty-Fla) W69-02463

## HOOD V SLEFKIN (SUIT TO ENJOIN DAM OWNER FROM CHANGING WATER LEVEL).

For primary bibliographic entry see Field 04A. For abstract, see . W69-02465

ASPECTS OF ACID MINE CHEMICAL DRAINAGE.

Pennsylvania State Univ., University Park; and Michigan State Univ., East Lansing.

H. L. Barnes, and S. B. Romberger. J Water Pollut Contr Federation, Vol 40, No 3, Part 1, pp 371-384, Mar 1968. 14 p, 5 fig, 1 tab, 15

Descriptors: \*Acid mine water, \*Mine drainage, \*Coal mines, \*Water pollution sources, \*Hydrologic aspects, \*Water pollution treatment, Bactericides, Neutralization, Carbonate rocks, Appalachian Mountain Region.

Identifiers: \*Acid drainage prevention, Inorganic sources, Chemical environment.

Acid mine drainage is discussed in terms of the conditions of its formation, prevention of acid production, and treatment of acid waters. Environmental Eh and pH vary widely among places where oxidation of iron sulfides releases sulfuric acid in mine waters. At high Eh, direct reaction of sulfides with dissolved oxygen releases acid; at low Eh, no thermodynamically reasonable mechanism compatible with field observations has been found. In simple hydrologic situations, carbonation saturation of mine drainage water may prevent acid formation, but bactericides, air-sealing of mines, and passivation of mineral surfaces are unlikely to be effective. Culturing of sulfate-reducing bacteria might be beneficial for flooded mines. Treatment of acid drainage by finely ground carbonate-rich rocks is an economical method; dilution and buffering of acid by mixing with bicarbonate-rich waters is preferable. The principal problem in treatment is removal of ferric oxhydroxide hydrate from suspension. (Knapp-USGS) W69-02518

#### CONTROL OF MINE DRAINAGE WATER.

Pennsylvania State Univ., University Park. Harold L. Lovell, and E. Bruce Jones. Proceedings of the Third Annual American Water Resources Conference 1967, pp 314-324, 11 p, 2

Descriptors: Mine wastes, Coal mine wastes, Mine drainage, Water pollution treatment, Water pollution control, Flash distillation, Neutralization, Sulfides, Iron compounds.

Identifiers: Pennsylvania State University, Solidfluid separation.

Coal mine drainage creates a stream contamination problem which currently plagues several eastern states. It introduces iron, aluminum and sulfate ions as well as sulfuric acid into receiving streams and frequently produces unsightly sediments on stream bottoms. These constitute an environment which is generally incompatible with aquatic life, recreation use and industrial water requirements. Such pollution develops naturally under proper environmen-tal conditions but it is enhanced by mining operations. Corrective approaches to these pollution conditions include prevention of its formation, amelioration, diversion to areas where the contamination might be less innocuous, and water treatment for the removal of the contaminants. At the present time, one of the approaches being taken by the Pennsylvania State University is the construction of a versatile experimental plant for treating such waters. (Seneca-Rutgers) W69-02539

# DIGITAL SIMULATION OF ESTUARINE WATER QUALITY, National Center for Air Pollution Control, Dur-

ham, N. C.; and Agricultural Research Service, Fort Collins, Colo.

Richard B. Dornhelm, and David A. Woolhiser. Water Resources Research, Vol 4, No 6, pp 1317-1328, December 1968, 12 p, 9 fig, 10 ref.

Descriptors: Water quality, Model studies, Management, Stability, Dispersion, Waste dumps,

Identifiers: \*Digital simulation, \*Estuarine water quality, Partial differential equations, Finite-difference scheme, Delaware Estuary.

Partial differential equations describing the unsteady, one-dimensional mixing process in an idealized homogeneous, linearly expanding estuary are presented and solved numerically, using an implicit finite-difference scheme. These solutions portray the change in concentration of conservative substances with time and distance as a result of tidal fluctuations and variable inflow. Although the model presented is highly simplified in terms of estuarine geometry, experiments with varying boundary conditions can provide insight into the adequacy of the more commonly used quasi-steady-state models. (Seneca-Rutgers)

#### THE USE OF SIMULATION IN WATER RESEARCH.

For primary bibliographic entry see Field 06A For abstract, see. W69-02604

### EVALUATION OF COLUMBIA RIVER COOL-ING PROGRAM, Battelle Memorial Inst., Richland, Wash.

For primary bibliographic entry see Field 06A. or abstract, see W69-02607

#### SYSTEMS ANALYSIS FOR **QUALITY** MANAGEMENT,

Oregon State Univ., Corvallis; and Federal Water Pollution Control Administration, Portland, Oreg. For primary bibliographic entry see Field 06A. For abstract, see. W69-02608

## SYSTEMS ANALYSIS: AN ECONOMIST'S VIEW, Ohio State Univ., Columbus.

Systems Approach to Water Quality in the Great Lakes, Proc 3rd Annu Symp Water Resources Res, pp 117-126, Ohio State Univ, Sept 1967. 10 p.

Descriptors: \*Systems analysis, \*Economics, \*Water pollution control, \*Standards, Public benefits, Public rights, Marginal utility, Marginal costs, Pricing, Constraints, Lake basins, Mathematical models, Lake Ontario, Lake Erie, Recreation demand, Cost-benefit analysis, Aesthetics, Water policy, Taxes, Optimization.

Three approaches to the problem of optimally attaining water quality standards in a hypothetical lake illustrated the interdependency of economics and systems analysis and the problem of philosophical approach in setting and administering of those standards. System 1 called for the solution of a simple linear model, where the costs of

#### Techniques of Planning—Group 6A

pollution removal for all users of a lake were equated to the costs of all pollution imposed on the lake by polluters. The quality standard for the lake was assumed given. System 2 maximized the utili-ties to all individuals from pollutant and non-pollutant generating products, subject to their budget constraints. System 3 maximized the benefit-cost ratios of various products, subject to budget constraints, assuming benefits and costs were quantifiable. The problems and merits of each approach and their combination were discussed. (Gysi-Cornell) W69-02612

AN ECONOMIC APPROACH TO WATER QUALITY CONTROL,

Oregon State Univ., Corvallis.

Kenneth D. Kerri.

J Water Pollut Contr Fed, Vol 38, No 12, pp 1883-1897, Dec 1966. 15 p, 3 fig, 6 tab, 17 ref. See also

Descriptors: \*Water quality control, Sewage effluents, \*Sewage treatment, Biochemical oxygen demand, Digital computers, \*Dissolved oxygen, \*Economic efficiency, Estimated costs, Oxygen sag, Stream improvement, Water management (Applied), Waste storage, Municipal wastes, Pulp

Identifiers: Matrix, Willamette River (Oregon), Primary treatment, Secondary treatment.

An analytical model was developed which determined the degree of treatment required by each waste discharger along the Willamette River system in Oregon, in order to meet various effluent or system standards. A DO cost matrix contained the amount of oxygen-consuming wastes passing through a critical reach from each water discharger, the amount of waste removed by different degrees of treatment, and the cost of each degree of treatment for each discharger. The decision variable was the percent of waste removed at each point of discharge. The minimum cost solution was obtained from the matrix by nonlinear programming techniques, and this solution was inserted in the Streeter-Phelps oxygen sag equation to obtain the DO profile for the river. Several examples for various effluent and stream standards were computed and given. It was found that the cost of maintaining effluent standards was much higher than the cost of maintaining various stream standards. The model made possible the economic comparison of alternative management policies, and might justify larger stream sampling programs. (Gysi-Cornell) W69-02614

# A DYNAMIC MODEL FOR WATER QUALITY CONTROL, Sacramento State College, Calif.

Kenneth D. Kerri.

J Water Pollut Contr Fed, Vol 39, No 5, pp 772-786, May 1967. 15 p, 3 fig, 3 tab, 14 ref.

Descriptors: \*Water quality control, \*Sewage Descriptors: \*Water quality control, \*Sewage treatment, Biochemical oxygen demand, Dissolved oxygen, Economic efficiency, Alternative costs, Average costs, \*Benefit sharing, Comparative benefits, Marginal costs, Salvage value, \*Administrative decisions, Legislation, Sewage districts, \*Economies of scale.

Identifiers: Willamette River (Oregon), Associa-

From the conclusion of an earlier paper (W69-02614) that the establishment of stream quality standards obtained by nonlinear programming techniques resulted in lower treatment costs than the enforcement of effluent standards, a presenta-tion was made for the organization of river basin waste treatment associations. Cost curves showed that if all plants in the association were built as fixed output conventional plants, except for one pivotal plant which could be operated over a wide range, large economies could result. The pivotal plant would preferably have a low marginal treatment cost, a large discharge, and would be located just above the critical reach. The selection and size of the treatment facilities would be chosen by computer on the basis of the marginal and average cost curves of the plants. Capacity of the system would be sized on the 10- to 20-year low flow using real or simulated hydrologic data. The dynamic conditions of the association (expansion of municipalities and firms and changing standards) were discussed, and the results of numerical examples for new firms en-tering the association were tabled. (Gysi-Cornell)

#### STREAMFLOW REGULATION FOR ACID CONTROL,

Federal Water Pollution Control Administration,

Washington, D. C

G. K. Young, and L. F. Gitto. Proc IBM Sci Computing Symp Water and Air Resources Manage, pp 317-330, Oct 1967. 14 p, 6 fig, 5 ref, 1 append.

Descriptors: \*Acid streams, Data storage and Descriptors: "Actor streams, Data storage and retrieval, "Dynamic programming, "Regulated flow, "Regression analysis, "Reservoir operation, River flow, Least squares method, Statistical methods, Correlation analysis, Stream improvements of the control of the co ment, Water management (Applied), Water quality control, Fishkill.

Identifiers: \*Loss functions, Kiskiminetas River Basin, Allegheny River, Cumulative density func-

Dynamic programming was used to derive and optimum operating rule for flood control reservoirs in the Kiskiminetas River Basin, in order to keep the highly acidic discharges into the Allegheny River as close as possible to 20% of the total 'Kiski' plus Allegheny flow, and at the same time keep the reservoirs as empty as possible. Various loss functions were used in a forward looking dynamic programming technique for the period July 1 to October 1, 1954. Storage was constrained to be zero on the first and last days, and a maximum of 5% of the system total. A loss function which allowed only 2 occurences at ratios above 0.4 in the frequency distribution plot was chosen. The loss function was then tested for all summers in the 1954-64 interval, the system optimized, and from a linear regression of a subset (every seventh day) of the data, a relation for discharge as a function of reservoir inflow and Allegheny flow was obtained. Significant improvement (lowering) of the flow ratios, as compared to the actual ratios, occurred when the daily flows for 1954-64 were routed through the reservoirs using the operating rule. (Gysi-Cornell) W69-02618

#### WATERWAYS OBTAINED.

N C Gen Stat sec 74-25-31 (1964).

aspects, \*Mine drainage, Surface drainage, Ditches, Appraisals, \*Damages, Obstruction to flow, \*Mine wastes, Sediments, Runoff, Streams, Drains.

The procedures to be followed by one engaged in mining who finds it necessary to convey water over the lands of another are stated. A petition is to be made to the clerk of the superior court of the county in which the affected lands are situated. If the petition request is granted, the clerk appoints 3 appraisers to assess the damage. After the clerk has approved the report by the appraisers, petitioner has the right to make such drains, ditches or other necessary work, provided the damages assessed have been paid or tendered. This act makes it a misdemeanor to obstruct any drain or ditch constructed as authorized by this chapter. Waste, water, and sediment from mining and washing kaolin and mica are allowed to run off into the natural courses and streams. (Childs-Florida) W69-02700

### TAX EXEMPTION OF AIR AND WATER POL-LUTION ABATEMENT FACILITIES. N C Gen Stat sec 105-297 (16) (1967 Supp).

Descriptors: \*North Carolina, Legislation, Legal aspects, Administrative agencies, Local governments, \*Taxes, Sewage systems, \*Treatment facilities, Air pollution, Water pollution, \*Pollution abatement, Permits, Public utilities.

Identifiers: Board of water and air resources, Tax

Air cleaning devices, sewage and waste treatment radicties, and air or water pollution abatement equipment are exempted from taxation. The requirements for obtaining this exemption are stated in this act. (Childs-Florida)

#### CONTAMINATING WATER SUPPLIES.

La R S 14:58 (1965).

Descriptors: \*Louisiana, Legislation, \*Water pollution, Water supply, Legal aspects, \*Public health, Domestic water.
Identifiers: \*Penal statute.

This act prohibits the intentional performance of any act tending to contaminate any public or private water supply. When the act foreseeably endangers the life or health of human beings, the penalty is more severe. (Childs-Fla) W69-02726

#### 06. WATER RESOURCES **PLANNING**

#### 6A. Techniques **OF Planning**

#### THE DEMAND FOR INLAND WATERWAY TRANSPORTATION,

Purdue Univ., Lafayette, Ind.

Eugene Silberberg. Water Resources Research, Vol 2, No 1, pp 13-29, First Quarter 1966. 17 p, 16 tab, 8 ref.

Descriptors: \*Transportation, \*Inland waterways, \*Coals, Rates, Demand, Supply, Forecasting, Mis-

sissippi River, Linear programming, Costs, Cost-benefit analysis, Tariff, Efficiencies. Identifiers: Demand for transportation, Barge transportation, Trade pattern, Interregional coal flows, Freight rates, Aggregation.

A new type of forecasting model of great potential for predicting flows in complicated spatial trans-portation networks is illustrated through application to the forecasting of interregional coal flows by barge over the Mississippi River system. Changes in these flows are related to regional coal production and consumption levels and to the freight charges by barge and rail. The special feature of the model is the great saving on the data needed for its implementation made possible by assuming that transportation patterns will be efficient, i.e., least-cost, for given regional imports and exports. This assumption is incorporated by using the linear programming transportation method to generate individual flows from regional barge imports and exports forecasts by a system of statistically fitted equations. Various applications are illustrated. (Seneca-Rutgers) tion to the forecasting of interregional coal flows by equations. Various (Seneca-Rutgers) W69-02535

## MEAN RANGE OF LINEARLY DEPENDENT NORMAL VARIABLES WITH APPLICATION TO STORAGE PROBLEMS, Colorado State Univ., Fort Collins.

Vujica Yevjevich.
Water Resources Research, Vol 3, No 3, pp 663-671, Third Quarter 1967. 9 p, 5 fig, 3 tab, 2 ref.

Descriptors: Markov processes, Average, Water storage, Monte Carlo method.

## Field 06—WATER RESOURCES PLANNING

## Group 6A—Techniques of Planning

Identifiers: \*Mean range, \*Normal variable, Autocorrelated, Linear dependence, Simple moving average. Autoregressive schemes.

The exact equations for the mean range of some normal but autocorrelated variables, of known population means and known linear dependence, are developed. The basic hypothesis was that the exact expression in the general form for the mean range of linearly dependent normal variables is the same as for the normal independent variable, which form was derived from the mean range given by Anis and Lloyd. The data generation method (with a large sample of 250,000 random numbers) was to assess the differences in mean ranges between the developed equations and the computer results. For three cases, a first and secondorder Markov linear dependence and the simple moving average scheme, the differences are very small, and they are of the order of magnitude of the sampling errors for the data generation method. The expressions for exact values of mean range are derived for: (1) the general Markov linear dependence model; (2) the first-order Markov linear dependence; (3) the general linear moving average scheme; and (4) the simple linear moving average scheme. (Seneca-Rutgers) W69-02538

#### A NOTE ON THE AVERAGE PROBABILITY OF EXTREME EVENTS,

Geological Survey, Miami, Fla. For primary bibliographic entry see Field 02E. For abstract, see . W69-02548

## PERCEPTION OF FLOOD HAZARD IN A SMALL NEW JERSEY TOWN, Rutgers-The State Univ., New Brunswick, N. J.

For primary bibliographic entry see Field 06F. For abstract, see . W69-02554

## A STOCHASTIC MODEL FOR OPERATING A MULTIPURPOSE RESERVOIR, Federal Water Pollution Control Administration,

Washington, D. C.; and Cornell Univ., Ithaca, N. Y.

Gary N. Dietrich, and Daniel P. Loucks. Proc Ser No 3, Symp Amer Water Resour Ass, San Francisco, Calif, pp 92-104, Nov 1967. 13 p, 2 tab,

Descriptors: \*Reservoir operation, Optimum use, Flood control, Inflow, Multiple purpose reservoirs, Water storage, Recreation, Streamflow, Fish and wildlife, Hydroelectric power, Drawdown, Reservoir storage, Models, Computer programming, Irrigation water, Mathematical analysis, Synthetic hydrology, Stochastic processes, Hydrology, Time. Identifiers: \*Operating criteria.

A stochastic linear programming method for defining optimal operating policies for a multipurpose reservoir is discussed. An operating policy refers to a schedule that specifies the amount of water to be released from the reservoir in any given time period and for any given condition of reservoir volume and previous inflow. An optimal policy prescribes and previous inflow. An optimal policy prescribes those releases that satisfy operating objectives. The linear programming model considers time periods, transition probabilities, constraints, objective functions, and alternative objectives in developing equations for reservoir operation. A 2-part problem illustrates the model developed. The first part involves determining an optimal operating policy for a reservoir serving the functions of hydroelectric power production, irrigation water supply, streamflow maintenance, recreation on the reservoir, and flood control. The second part involves determining the operating policy for the same reservoir with streamflow maintenance deleted from the requirements. Results of the calculations are included. (USBR)

UNBALANCED BIDDING MODELS-THEORY, Delaware Univ., Newark.

Robert M. Stark. Proc Amer Soc Civ Eng, J Constr Div, Vol 94, No CO2, pp 197-209, Oct 1968. 13 p, 3 tab, 6 ref, 5

Descriptors: Contracting, Models, Construction costs, \*Contracts, \*Bids, Mathematical analysis, \*Linear programming, Mathematical models, Administration, Economies, Theory, Costs, Computation, Analysis, Cost analysis, Contract administration, Digital computers, Investment, Unit costs,

A class of unbalanced bidding problems appropriate for unit price proposals is identified. Using the present worth of future revenue as an objective, several models are constructed for optimal unbalancing of a bid. A linear programming formulation emerges in a natural way. The implications of unbalanced bidding to the bidder and sponsor are considered. An advantage of the models is their demand for more thorough proposal and bid preparation. The lowest bid does not necessarily mean the lowest cost of the project. Another feature of the models is that they permit either or both parties, through constraints, to exercise any control they deem desirable. It is easy to compare the gain from an unbalanced bid, using the models developed in the paper. Models with a simple numerical example are illustrated. (USBR) W69-02602

#### THE USE OF SIMULATION IN WATER RESEARCH.

SEMINAR WR 006.67, Oregon State Univ. Corvallis, Jan 1967. 122 p, 26 fig, 3 tab, 41 ref.

Descriptors: \*Simulation analysis, Computer models, \*Research and development, River basin development, River regulation, Stream improve-ment, \*Water resources, Water quality control, Planning, Flood damage, Digital computers, Analog computers, Thermodynamic behavior, Decision making. Identifiers: Willamette River, Columbia River,

Oregon State University.

Eight papers and one abstract described presentations given at an Oregon State University seminar on simulation in the fall of 1966. The 'History and on simulation in the fall of 1900. The History Significance of Simulation Models, a comparison of 'Digital vs Analog Models,' the 'Biological Considerations in Water Management,' the interaction of 'Simulation and Public Decision Making,' and the 'Advantages and Dangers of Simulation' were all discussed. The economic effect of a change in a reservoir decision rule on downstream flood damages was illustrated in a paper on 'Analytic Simulation'. A simulation model, used to predict river temperature downstream of several reservoirs dependent on inflow, and air temperatures, discharge, wind velocity, sky cover, reservoir size, etc, was presented in a paper on 'Evaluation of Columbia River Cooling Program'. A predictive water quality model for the Willamette River, which used the 'STORET' storage and retrieval program, was presented in 'Systems Analysis for Quality Management'. (Gysi-Cornell) W69-02604

#### ANALYTICAL SIMULATION,

Oregon State Univ., Corvallis. Dale D. McFarlane.

Use of Simulation in Water Research, SEMINAR WR 006.67, pp 17-29, Oregon State Univ, Jan 1967. 13 p, 2 fig, 2 tab.

Descriptors: \*Simulation analysis, Water resources development planning, \*Flood control, Flood damage, Flood forecasting, Decision making, \*Reservoir operation, Analytical techniques, Comparative costs, Design flood, Hydrologic data, Risks, River regulation.

The purposes and methodology of analytical simulation were introduced, and an application of its

use was illustrated by a flood control model. General applications of simulation to water resources planning and development were discussed and diagrammed. A specific application of the comparison of decision rules for controlling a hypothetical reservoir's outflow was given. The objective was to determine the decision rule which minimized downstream flood damage. Decision rule 1 called for the release of the maximum amount of water in any period, without exceeding the flood stage outflow, if possible. Decision rule 2 called for the same release, unless the predicted 6 month average future inflow exceeded the flood stage flow, in which case the 6 month predicted average was released. Results for the two rules were tabled. Decision rule 2 dominated decision rule 1 for the assumed (exponential) damage function used. (Gysi-Cornell) W69-02605

#### DIGITAL VS ANALOG MODELS,

Oregon State Univ., Corvallis.

Lovis N. Stone. In Use of Simulation in Water Research, SEMINAR WR 006.67, pp 31-41. Oregon State Univ, Jan 1967. 11 p.

Descriptors: \*Analog computers, \*Digital computers, \*Simulation analysis, Analytical techniques, Water resources development, Analog models, \*Comparative costs, Computer models, Economic efficiency.

Identifiers: \*Hybrid computers, Digital differential analyzer, Dynamic simulation, Oregon State University.

A comparison of present and future use of digital and analog computers for simulation, including digital differential analyzers and hybrid computers was given. The basis for discrete whole number operation of the digital computer using a memory and arithmetic unit was compared to the continuous operation of the analog computer which uses high gain amplifiers. The digital differential or incremental digital computer, and the hybrid computer which is a union of the analog and digital computers were discussed. Advantages and limitations of each type were presented. Examples of the speed and cost saving abilities of computers for simulation were given. Present and future capabilities for computer simulation in the United States, and Oregon State University in particular, were outlined (Gysi-Cornell) W69-02606

### EVALUATION OF COLUMBIA RIVER COOL-ING PROGRAM, Battelle Memorial Inst., Richland, Wash.

Robert T. Jaske.

In Use of Simulation in Water Research, SEMINAR WR 006.67, pp 43-71, Oregon State Univ, Jan 1967. 29 p, 11 fig, 13 ref.

Descriptors: Digital computers, \*Simulation analysis, Thermal water, \*Heat budget, Cooling water, \*Reservoir operation, \*River regulation, \*Temperature control, Flow control, Meteorological data, Mixing stream improvement, Water management (Applied). Identifiers: Columbia River, Grand Coulee Dam, Hanford Persister.

Hanford Project.

A simulation model used to predict river temperatures downstream of a series of reservoirs was presented and the results of three years programmed releases from Grand Coulee Dam to reduce river temperatures at the Hanford project were reported. The simulation program named COL HEAT was based on a 1962 head budget study. Basic assumptions of the model, such as dis-cretization of cross-sectional flow, averaging of in-puts, and use of single point data sources were evaluated. Since the program required iterative computational techniques a digital computer was used. The program was verified using historical data. Parametric studies indicated that Grand Coulee release temperatures contributed the major effect

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to river temperatures for downstream. The effects of low and high tube, and spillway programmed releases to effect downstream temperatures were reported. (Gysi-Cornell) W69-02607

SYSTEMS ANALYSIS MANAGEMENT, FOR QUALITY

Oregon State Univ., Corvallis; and Federal Water Pollution Control Administration, Portland, Oreg. Fred J. Burgess, and J. Larry Worley.
In Use of Simulation in Water Research,

SEMINAR WR 006.67, pp 85-109, Oregon State Univ, Jan 1967. 25 p, 12 fig, 11 ref.

Descriptors: \*Systems analysis, \*Water quality control, Water management (Applied), \*Data storage and retrieval, River regulation, \*Flow augmentation, Gaging stations, Dissolved oxygen, Oxygen requirements, River basins, Temperature, Waste treatment, Stream improvement, Optimization, Reservoir operation. Identifiers: Willamette River, Oregon.

A computer study was used to find the optimum flow augmentation scheme necessary to meet minimum dissolved oxygen standards in a river system. The system of analysis is described and shown schematically on a simplified logic diagram. It involved starting at the upstream reach, and iteratively incrementing flow augmentation where possible to meet minimum DO requirements. The model used modified forms of the Streeter-Phelps equations. Results of some parametric studies of the Willamette River in Oregon were discussed and shown in figures. The effect of water temperature on augmentation requirements was discussed. A

data storage and retrieval system (called STORET), which is a national system devised for efficient computer handling of streamflow data was described. (Gysi-Cornell) W69-02608

DESIGN **OPERATIONS** RESEARCH.

Illinois Univ., Urbana.

In Chow, V T Handbook of Applied Hydrology, New York, McGraw-Hill, 1964. pp 26-47, 2 fig, 66

Descriptors: \*Operations research, Optimum development plans, Design criteria, Economic efficiency, Marginal benefits, Marginal costs, Flood control, Simulation analysis, Linear programming, Dynamic programming, Statistical models

A short review of operations research techniques and their applications to the design of water resources was presented. Some design criteria and economic concepts associated with public water resources development were given. The two techniques presented wee simulation and mathematical programming. Under simulation, the author discussed briefly sampling techniques, operating procedures, and sequential generation of hydrologic data. Under the mathematical programming section, both general deterministic and stochastic linear and dynamic programming models were structured and discussed. (Gablinger-Cornell) W69-02609

OPTIMUM IRRIGATED PRACTICE UNDER CONDITIONS OF DEFICIENT WATER

SUPPLY, California Univ., Los Angeles. Warren A. Hall, and Nathan Buras. Amer Soc of Agr Eng, Trans, Vol 4, Gen Edition No 1, pp 131-134, 1961. 4 p, 4 fig, 2 ref.

Descriptors: \*Dynamic programming, \*Irrigation efficiency, Water shortage, Return (Monetary), Optimization, Net profit, Homogeneity, Mathematical models.

Dynamic programming was used to determine the optimum (maximum return) irrigation practices under conditions of deficient water supply. The problem was structured for a multi-unit irrigation form, assuming the expected value of the net economic benefit was known and identical for all crops. A special case of irrigation of homogeneous lands was structured and solved by a simple graphical procedure based on the dynamic programming technique. The postulate of identical return functions implied that a single crop or very similar crops were to be grown, otherwise the land to be devoted to different crops might be considered as a separate problem. (Gablinger-Cornell)
W69-02610

SYSTEMS ANALYSIS: AN ECONOMIST'S

VIEW, Ohio State Univ., Columbus. For primary bibliographic entry see Field 05G. For abstract, see . W69-02612

ECOLOGICAL SYSTEMS ANALYSIS AND WATER QUALITY,

Oak Ridge National Lab., Tenn. For primary bibliographic entry see Field 05C. For abstract, see . W69-02613

AN ECONOMIC APPROACH TO WATER QUALITY CONTROL, Oregon State Univ., Corvallis.

For primary bibliographic entry see Field 05G. For abstract, see . W69-02614

A DYNAMIC MODEL FOR WATER QUALITY CONTROL.

Sacramento State College, Calif. For primary bibliographic entry see Field 05G. For abstract, see . W69-02615

THE INFLUENCE OF UNCERTAINTY IN STREAMFLOW ON FIRM POWER COMMIT-HYDROELECTRIC **POWER** IN SYSTEMS,

Stanford Univ., Calif. Oswaldo Alberto Armitano-Matheus. Rep CCS-7, Inst In Eng-Econ Syst, Stanford Univ, Dec 1965. 43 p, 7 fig, 3 tab, 4 ref, 3 append.

Descriptors: \*Hydroelectric power, Stochastic processes, Streamflow, Synthetic hydrology, \*Scheduling, Simulation analysis, Statistical methods, Reservoir storage, Probability, Economic efficiency, Mathematical models, Digital computers, Benefits, Electric power demand. Identifiers: Nonlinear programming, \*Gradient projection method, Firm power commitment.

Nonlinear programming techniques (gradient projection methods) were used to obtain firm and secondary power commitments for a hydroelectric company, under the uncertainty of stream Asw. The objective was to maximize the expected set profit, assuming power demands were known with one degree of freedom, and system generating capacities were given. To overcome the high dimensionality of the stochastic streamflows, a model of the system was used to obtain a new random variable, the maximum hydroelectric power available per historical year. Two methods were developed to obtain the new variable: one for a single-dam case used an iterative simulation technique, the other for a multi-dam case used the gradient projection technique. The probability density function inferred from the values of maximum power available per year was used to obtain the power commitments that maximized expected profits. Hypothetical one- and two-dam examples were appended. (Gysi-Cornell) W69-02616

STREAMFLOW REGULATION FOR ACID CONTROL, Federal Water Pollution Control Administration,

Washington, D. C

For primary bibliographic entry see Field 05G. For abstract, see . W69-02618

THE OPTIMUM USE OF A GROUND-WATER AND SURFACE-WATER SYSTEM: A PARAMETRIC LINEAR PROGRAMMING AP-PROACH,

California Univ., Berkeley.

Tech Rep 6-24, Water Resources Center, Contrib No 107, Hydraul Lab, Univ of Calif, Berkeley, July 1966. 134 pp, 17 fig, 23 tab, 55 ref.

Descriptors: \*Conjunctive use, \*Linear programming, Surface-ground water relationships, Artificial recharge, Water distribution (Applied), Water demand, \*Water resources development, Reclaimed water, Decision making, \*Optimization, Economic efficiency, Irrigation water, Municiple

Identifiers: Sensitivity analysis, \*Parametric analysis, San Gabriel Valley, California, Imported water.

A parametric linear programming model was used to find the optimal ground-water and surface-water allocation for a 30-year period in the San Gabriel Valley of California. The parametric analysis included variation of objective function cost coefficients and the requirements vector of the constraint set. Unit costs were determined by economic analysis. Five sources of water (local surface water, imported water from 2 sources, ground water, and reclaimed waste water) were utilized optimally to satisfy three water requirements (municipal and industrial, agricultural, and artificial recharge). Three possible decision rules were analyzed to determine optimum operating procedures. A sensitivity analysis on the cost coefficients, and the significance of the imputed prices, was included. It was concluded that the method was effective as a guide for long range optimum decision making for water resource systems. (Gysi-Cornell) W69-02619

REVITALIZING A FERTILE PLAIN,

Harvard Univ., Cambridge, Mass.

Myron B. Fiering. Water Resources Res, Vol 1, No 1, pp 41-61, Jan-Mar 1965. 21 p, 20 fig, 4 tab, 1 chart, 5 ref, 1 ap-

Descriptors: Aquifers, \*Computer programs, Cor-Descriptors: Aquiters, \*Computer programs, Correlation analysis, Seasonal, \*Simulation analysis, Economic efficiency, Hydrologic data, Irrigation design, \*Optimum development plans, Drawdown, Deep-well pumping, \*Drainage wells, Well spacing, \*Water table, Salinity.

Identifiers: Indus River (West Pakistan).

The application of systems analysis and digital computer simulation to the control of waterlogging and salinity in West Pakistan was described. A single well field model was structured, the exogenous, endogenous, state and decision variables were defined and the computer program presented. The model was constructed with four seasons per year, using stochastic hydrologic input data. Assumptions in the computation, operating policy, and results of the program were discussed. A multiwell model was also structured. Example results were displayed in figures and tables indicating the most efficient rate and pattern of well spacing. (Gysi-Cornell) W69-02620

DESIGN OF OPTIMAL HYDRAULIC NET-

WORKS, Boeing Co., Renton, Wash. For primary bibliographic entry see Field 08B. For abstract, see . W69-02621

#### Group 6A — Techniques of Planning

DYNAMIC PROGRAMMING METHODS AP-PLIED TO WATERSHED MANAGEMENT PROBLEMS,

California Univ., Los Angeles.

Nathan Buras.

Amer Soc of Agr Eng, Trans, Vol 5, Gen Edition No 1, pp 3-5, 1962. 3 p, 12 ref.

Descriptors: \*Dynamic programming, Mathematical models, Watershed management, Runoff, Forage grasses, \*Brush control, Staistical models, Discount rate.

Dynamic programming was used to determine the conversion of the vegative cover of a watershed from brush to grass. By this conversion, a dual benefit may be realized: (1) the range is improved and (2) more water becomes available for runoff. The problem was structured for both deterministic and probabilistic growth conditions. Discounting and solution procedures for linear and non-linear return functions were discussed. (Gablinger-Cor-

nell) W69-02622

## PROJECT YIELDS BY A PROBABILITY

Colorado River Board of California, Los Angeles. W. Don Maughan, and R. Y. Kawano. Amer Soc Civil Eng Proc, Vol 89, No HY3, pp 41-60, May 1963. 20 p, 10 fig, 6 tab, 9 ref.

Descriptors: Design flow, Digital computers, Economic efficiency, Frequency analysis, Hydrologic data, \*Streamflow forecasting, \*Reservoir design, Reservoir operation, \*Probability, Project planning, Risks, \*Statistical methods, Sampling, \*Synthetic hydrology. Identifiers: Deviation, \*Safe yield, Firm draft,

\*Confidence limits.

A statistical computation method for estimating safe yield from a proposed reservoir was presented, and applied to an illustrative example for the Glen Canyon Reservoir. It was assumed that fairly long streamflow records existed, that the flows were semirandom events, the reservoir had some designated volume at the beginning of the study period, and that the reservoir could be operated hypothetically to obtain the safe yield. 66 years of record were used to semirandomly create 100 sets of 50-year synthetic streamflow data. A digital computer program performed the statistical computations and plotted graphs of cumulative departures from the mean for each sequence. Manual graphical analyses of the results gave the safe yield for each sequence. Statistical analyses of the 100 safe yields resulted in the establishment of confidence limits for the annual safe yield, depending on the initial state of the reservoir. Mass analyses could be carried out for various sized reservoirs. resulting in different safe yields for a chosen degree of risk. An economic analysis would then be used to determine the optimum reservoir size. (Gysi-W69-02623

## WATER RESOURCE CONSTRAINTS ON A RE-

GIONAL ECONOMY,
Pennsylvania State Univ., University Park. Inst. for
Research on Land and Water Resources.

David L. Raphael.

American Water Resources Association,
Proceedings, Third Annual American Water
Resources Conf., San Francisco, 1967, pp 617-629.
12 p, 1 fig, 3 tab, 5 ref.

Descriptors: \*Operations research, Analytical techniques, Methodology, Regional analysis, Model studies, Mathematical models, \*Leontief models, Structural models, Estimating, Theoretical analysis, Water supply, Demand. Identifiers: Clinton County (Pennsylvania).

The report is an attempt to adapt a class or mathematical models, used elsewhere, to the field of Water Resources Studies. The models are of the Leontief input-output model type and have a suc-

cessful history of application. They fall into the body of knowledge generally subsumed under the headings Operations Research or Management Science. Presented is an attempt to make use of a complex and quantitative methodology in a new area of application. The specific goal of the paper is to discuss the development of meaningful water resource constraints for a regional economy. The general water supply-demand mode is discussed, with specific application to Clinton County, Pennsylvania. A pilot version of a water supply-de-mand model for Clinton County has been completed. It consists of two interconnected linear flow, input-output models. These are: (1) an economic money flow model simulating the economy of the county, and (2) a water flow model simulating the water supply demand relationships operating within the county region. The programming problems are discussed and the mathematical development of the models presented. (Gargola-Chicago)

#### **6B. Evaluation Process**

WATER BASED RECREATION IN NEVADA:

TAHOE, Nevada Univ., Reno. Div. of Agricultural

Nevada Univ., Reno. Div. of Agricultural Economics and Education. George A. Myles. Max C. Fleischman - College of Agriculture, University of Nevada, pub. No. B-10, pp 1-22, Nov. 1966. 28 p, 1 map, 3 photo, 7 tab, 2 ref.

Descriptors: \*Recreation demand, \*Personal surveys, Age, Education, Average income, Invest-ment. Weather data.

Identifiers: Economics, \*Nevada, \*Recreation.

During the summer of 1965, a personal interview type of survey was conducted at Lake Tahoe, Nevada. The purpose of the study was to acquire information concerning the use of water based recreational areas; desire for or satisfaction with facilities and services; the using public's willingness to pay for use of areas and facilities; the expenditures of visitors; and characteristics of recreational users and the effect of these characteristics on demand for various areas, facilities, and services. Opinions and recommendations for the improvement of the existing facilities were obtained from the visitors. The information acquired is useful in estimating the market potential from site visitors and in planning future developments. (Grossman-Rutgers) W69-02401

### WATER BASED RECREATION IN NEVADA: WESTERN DESERT AND NORTHERN LAKES,

WESTERN DESERT AND NORTHERN LAKES, Nevada Univ., Reno. Div. of Agricultural Economics and Education. George A. Myles. Max C. Fleischman - College of Agriculture, University of Nevada, Pub No. B 14, pp 1-74, March 1967. 84 p, 3 map, 8 photo, 22 tab, 7 charts, 3 append 4 ref 3 append, 4 ref.

Descriptors: \*Recreation demand, \*Personal surveys, Age. Education, Average income, Invest-ment, Weather data.

Identifiers: Economics, \*Nevada, \*Recreation.

A survey of all visitors to Pyramid Lake, Lahontan Reservoir, Topaz Lake, Walker Lake, Rye Patch Reservoir, Wildhorse Reservoir, and other northeast water recreation areas in Nevada was conducted during the summer of 1965. The purpose of the survey was to acquire information con-cerning the use of water based recreational areas; desire for or satisfaction with facilities and services; the using public's willingness to pay for use of areas and facilities; the expenditures of visitors; and characteristics of recreational users and the effect of these characteristics on demand for various areas, facilities, and services. In addition to infor-mation about the characteristics of the visitors, their recommendations were obtained. Photographs, maps, and data are included in the report. (Grossman-Rutgers) W69-02402

### WATER BASED RECREATION IN NEVADA, MEAD AND MOHAVE, Nevada Univ., Reno. Agricultural Experiment Sta-

George A. Myles.

Max C. Fleischman College of Agriculture, Report B-13, pp 1-24, Dec 1966. 28 p, 6 photo, 7 tab, 2 ref, 1 append.

Descriptors: \*Recreation demand, \*Surveys, \*Costs, Education, Average income, Occupations. Identifiers: Economics, \*Nevada, \*Recreation.

The survey method was used to determine information concerning recreational areas, desire for or satisfaction with facilities and services, the using public's willingness to pay for use of areas and facilities, the expenditures of visitors, and characteristics of recreational users and the effect of these characteristics on demand for various areas, facilities and services. Visitors made some suggestions for improvement in respect to providing shade or greenery, clean beaches, removing rocks and improving surfaces, and enlarging camp grounds. Most visitors participated in relaxation and swimming. Other activities of visitors included camping, sightseeing, and photography. The average daily expenses of those interviewed were \$18.29. (Grossman-Rutgers) W69-02403

#### CONCEPTUAL PROBLEMS IN WATER QUALI-TY ECONOMICS, California State Water Resources Control Board,

Sacramento.
Virgil Whitely, and Bill B. Dendy.

Journal of the Sanitary Engineering Division, Am. Soc. Civ. Engr., pp 841-848, Oct 1968. 8 p.

Descriptors: \*Water pollution control, Water quality act, \*Water quality control, \*Economic efficiency, Economic benefits, Economic justification, \*Economic feasibility, Benefit cost analysis, Aesthetics, Public health recreation.

An economist and an engineer on the staff of the California State Water Resources Control Board consider water-quality economics, as a result of responsibilities placed upon their agency in connection with the San Francisco Bay-Delta Water-Quality program. The authors are concerned by statements of the Federal Water Pollution Control Administration implying that the pollution control program should proceed regardless of economics. It is pointed out that if economic efficiency is to be a criterion for water quality projects, it is necessary to determine justification for water quality of a given level. The authors consider that water quality benefits, other than physical effects such as reducing water treatment costs, can be classified under the headings of recreational improvement, public health and aesthetics. Recreational values can be evaluated, but as yet there is no consensus as to the best approach. The category of aesthetic effects is obviously considered in a rather broad sense, since the suggested evaluation approach is through land values. The authors consider that tangible values evaluated by such means may not be enough to justify a project in themselves; but they are a useful indicator, to be supplemented by consideration of in-tangibles. (Whipple-Rutgers) W69-02404

## MEASUREMENT OF THE IMPACT OF RECREATION INVESTMENTS ON A LOCAL

Wisconsin Univ., Madison; and Cornell Univ., N.

Robert J. Kalter, and William B. Lord. Amer Jour of Agric Econ, Vol 50, No 2, pp 243-245, May 1968. 14 p, 2 tab, 21 ref.

#### **Evaluation Process — Group 6B**

Descriptors: \*Input-output analysis, \*Recreation. \*Public benefit, Incomé, Investment, Direct benefits, Indirect benefits, Employment, Wisconsin, Regional analysis.

Identifiers: From-to analysis, Interindustry model. Sales multiplier.

A from-to type of interindustry model is formulated and empirically implemented to quantify local economic impacts of a transfer nature arising from outdoor recreation. Direct, indirect, and induced sales, income, and employment impacts are derived and multiplier values are calculated. Relationships among the from-to model, supplemental studies, and the analysis of regional benefits for governmental investment decisions are discussed. The multiplier values permit comparisons to be made of the impact of demand changes on the regional economy, and through the use of income multiplier values, provide a means of determining the benefits of various activities on the regional economy. The from-to model provides an operationally feasible method for determining the regional benefits resulting from governmental activities and for analysing regional economies.

W69-02410

# THE MARKET FOR WATER BASED OUTDOOR RECREATION SERVICES IN NEW CASTLE COUNTY, DELAWARE, Delaware Univ., Newark. Dept. of Economics.

For primary bibliographic entry see Field 06D For abstract, see . W69-02470

## CITY OF WILMINGTON WATER SYSTEM,

Delaware Univ., Newark. Urban Affairs Div. Francis X. Tannian.

Research Project Partial Technical Completion Report to Office of Water Resources Department of the Interior, Washington, D. C., November 1, 1968. 3 p. OWRR Project A-003-Del.

Descriptors: \*Wilmington Water System, History, Legal basis, Organization and staffing, \*Physical inputs, \*Physical outputs, Costs, Revenues, Excess capacity, \*Cost-benefit analysis.

This study examines the history of the Wilmington Water Department, its legal basis, organization and staffing, physical inputs and operating inputs, output and its allocation, costs, revenues and pricing. The department serves customers outside the city limits, and residents of unincorporated areas of the county. Its service area is not clearly defined by law or practice, and this should be clarified to facilitate planning. Improvements in organization and staffing are required. Physical inputs--source, land, storage system, purification facilities, pumping stations, and distribution system--are described with particular attention to age and capacity, and then related to physical output. The system has excess capacity which will gradually diminish but not be eliminated until about the year 2000. Output is purchased by residential and nonresidential customers in the city and the country; county rates are twice the city rates, with certain exceptions.
The rate structure produces an effective price per 1,000 gallons that varies inversely with meter size and consumption, and this favors large volume users. As a result, revenues from residential users are proportionately greater than their consumption, while revenues from nonresidential users are proportionately less. Insofar as proportionate usage reflects cost of service, the former users subsidize the latter. A comparison of effective price per 1,000 gallons for each meter size with average cost per 1,000 gallons also suggests a subsidy to large volume users. The subsidies produced by the present pricing system (block rate structure) can be eliminated or minimized by several alternative pricing arrangements which better equate revenue collected from users with the cost of serving them. The excess capacity of the water system could be used to earn revenue by selling water to neighboring systems. W69-02471

ECONOMIC AND ENGINEERING FEASIBILI-TY OF A UNIFIED WATER SYSTEM FOR NORTHERN NEW CASTLE COUNTRY, DELAWARE.

Delaware Univ., Newark. Urban Affairs Div. Marvin R. Brams.

Research Project Partial Technical Completion Report to Office of Water Resources Research, Department of the Interior, Washington, D. C., November 1, 1968. 4 p. OWRR Project A-003-Del.

Descriptors: \*Unified water system, \*Economic Descriptors: \*United water system, \*Economic feasibility, \*Engineering feasibility, \*Input-output analysis, \*Cost-benefit analysis, Costs of unification, Benefit of unification, Physical unification, Administrative unification, Efficiency, Equity.

Northern New Castle County, Delaware is served by 12 independent water systems, 7 are private companies and 5 are municipal. Each is important to the area it serves, but all are not of equal importance when viewed as components of a County system. Interconnections allow intersystem transfers of water, but not all systems are interconnected. An engineering consultant examined the physical aspect of unifying supply and distribution systems and concluded that (1) there are a number of short-term opportunities for intersystem transfer not now being utilized, but these opportunities would vanish in the long run because the eventual demands on each system would require all of its present resources, (2) wholesale unification of distribution systems was not feasible, but there are several areas where it looks promising and impor-tant benefits could result. The limits of physical unification do not preclude complete administrative unification. If the water systems were unified, partially or wholly, physically and administratively, under County ownership, many benefits would result. The many pricing policies of the independent systems could be replaced with fewer policies, perhaps only one. This would facilitate the control of water resources, and more equitably allocate cost to various user groups. Operating economies would result from economies of scale, and duplication of facilities would be avoided. Source of supply would be more efficiently distributed, and this could postpone or eliminate the need for additional facilities. Water would be of a higher and more uniform quality, and fire protection would be much improved. A framework conducive to comprehensive, county-wide planning for water resources would be created. The benefits of unification justify a range of purchase prices, of which many would be reasonable compensation. Partial unification could begin by purchasing the private systems, and this may prove a suitable compromise between no unification and complete unification in the event that municipal systems remain independent of, but cooperative with, the County system. The County would, no doubt, survive without partial or full unification, but water would be supplied and distributed less efficiently and at greater cost W69-02472

## THE NATION'S WATER RESOURCES SUMMARY REPORT.

Water Resources Council, Washington, D. C.

U S Water Resources Counc, pp 1-1--1-32, 1968. 32 p, 21 fig, 2 tab.

Descriptors: \*Water resources, \*United States, \*Surveys, Water requirements, Water utilization, Water Resources Planning Act, Federal government, Planning, Water policy. Identifiers: Water Resources Council.

summary report of the first National Water Resources Assessment describes the water and related land resources of the Nation, and presents the findings and recommendations of the Water Resources Council. The present and projected future uses of water and present and recommended management of water with its related land are described and recommendations are made. Water supplies and requirements are described for 20 regions in the U. S. (Knapp-USGS) W69-02498

THE RELATION OF WATER RESOURCES TO THE INDUSTRIAL AND RECREATIONAL POTENTIAL OF THE MISSISSIPPI GULF COAST,

Mississippi State Univ., State College. Bureau of Business and Economic Research.

A. A. Armenakis, R. F. Pearson, and W. P. Neely.

Miss State Univ Water Resources Res Inst, 228 p. 1968. 6 fig, 8 map, 44 tab, 128 ref, 2 append.

Descriptors: \*Water resources, \*Recreation, \*Industries, \*Water resources development, \*Missis-sippi, Groundwater, Surface waters, Water demand, Water management (Applied), Social aspects, Human population, Average income. Identifiers: Mississippi Gulf Coast.

Information from published water-resource reports and from questionnaires and interviews with water users in the Mississippi Gulf Coast Counties is compiled and analyzed in a study of the relation of water resources to industrial and recreational potential of the area. The major conclusions reached are that water is plentiful and of good quality for most uses, but the quality must be maintained if both industry and recreation are to in-crease to their potentially much greater role in the area. Waterborne transportation was an important factor in the choice of location of 62% of the area's industries. Improvements of channels and terminal facilities are part of the development plans of the area. Hancock, Harrison, and Jackson Counties have detailed water development plans of which reviews are included. (Knapp-USGS) W69-02499

## RECREATIONAL CONSIDERATIONS IN THE CALIFORNIA WATER PLAN,

California State Dept. of Water Resources.

M. J. Shelton.

In Proceedings-Conference on Recreational Use of Impounded Water, issued by Committee on Research in Water Resources, University of California, pp 27-34, December 1956. 8 p, disc.

Descriptors: Water requirements, waters, Distribution, Spawning, \*Multiple-purpose projects, \*California, \*Recreation.
Identifiers: \*California Water Plan, Economic growth, Water development.

Outdoor recreation in California is big business. It is estimated that the state's 1.9 million hunting and fishing license holders spend more than a quarter of a billion dollars annually in pursuit of their favorite sport. There are thousands of small impoundments in California, many of which are open to fishing, swimming, camping and other recreation activities. The physical effect of this projected water development in terms of available water is an increase in the number of major lakes in California by about 260 and the total surface acreage by many thousands. It is believed that public accessibility to recreational streams and lakes will be increased many fold. Many of the proposed reservoirs will block the spawning grounds of migratory fish, but even these unavoidable losses can be mitigated. In some instances, new reservoirs represent the only water playgrounds in large areas formerly having none at all. Water and outdoor recreation cannot be separated. That is why planning for both aspects of water development should be considered at the same time. (Seneca-Rutgers) W69-02526

#### THE ECONOMICS OF URBAN DRAINAGE,

Virginia Military Inst., Lexington, Va.

John W. Knapp.
Proceedings of the Third Annual American Water
Resources Conference, 1967, pp 631-640, 10 p, 2 fig, 4 tab, 6 ref.

Descriptors: \*Drainage systems, Urbanization, \*Costs, Benefits, Planning, Investment, Physical properties, Design, Regression analysis.

Identifiers: Prediction models.

## Field 06—WATER RESOURCES PLANNING

### **Group 6B—Evaluation Process**

Urbanization in the United States will require at least a billion dollar per year investment in new drainage facilities. Thus there is a need for planning aids to consider alternative designs. Examination of over 100 small urban drainage systems reveals that investment in convention systems depends upon design factors and characteristics of the drainage area. Physical properties, including geographic features of the basin and hydrologic characteristics, are the most significant cost components; however, design factors are also important. Regression techniques are used to explain differences in design methods and to develop prediction equations for cost studies of various levels of design. (Seneca-Rutgers) W69-02527

## PRESERVATION VALUES IN RIVER BASIN

Izaak Walton League of America. For primary bibliographic entry see Field 06D. For abstract, see. W69-02529

## COMPARING ATTITUDES TOWARD WATER

POLLUTION IN SYRACUSE, Syracuse Univ., N. Y. Maxwell Graduate School of Citizenship and Public Affairs. H. George Frederickson, and Howard Magnas. Water Resources Research, Vol 4, No 5, pp 877-889, Oct 1968. 13 p, 1 fig, 6 tab, 8 ref.

Descriptors: Water pollution control, Sewage sludge, Waste water, Sewage treatment. Identifiers: Public good, Onondaga County, Syracuse, Individual benefits, Public opinion, \*Social aspects, \*Political aspects.

A random sample survey of the attitudes of residents in Onondaga County, Syracuse, New York, toward water pollution and other local problems indicated the following: Water pollution is regarded as a middle-level public priority, coming after education and law enforcement in the view of suburban residents and after education, law enforcement, housing, and employment in the view of city residents. Traffic, road maintenance, parks and recreation, and welfare were regarded by both city and suburban residents as lower-order public pri-orities. The respondents felt directly affected by water pollution and associated it with various types of recreation. They regarded industry as a greater contributor to pollution than public jurisdictions and held local governments responsible for improving water quality. Respondents varied widely in their willingness to be taxed to abate pollution. Those with higher socioeconomic status were more willing to pay for pollution abatement than those with lower socioeconomic status. (Seneca-Rutgers) W69-02533

#### THE HUMAN FACTOR AND CHANGES IN WATER USAGE PATTERNS,

Utah State Univ., Logan.

H. Bruce Bylund. Water Resources Research, Vol 2, No 3, pp 365-369, Third Quarter 1966. 5 p, 8 ref.

Descriptors: Social aspects, Water resource development, \*Social change, Psychological aspects, Attitudes, Social adjustment, Motivation, Utah.

Identifiers: Bear River Project, \*Bureau of Reclamation, Rationality, Vested interests.

Many obstacles to the more efficient use of water resources are human rather than physical. Human obstacles are as real as physical ones and they must be dealt with if effective changes are to result. In the preliminary work on the Bear River Project two types of opposition were clearly demonstrated: general opposition to change at a covert emotional level and a more reasoned opposition by in-dividuals and groups with a vested interest. Those individuals and groups with vested interests used several tactics to sway public opinion. In some ways

opposition to proposed projects is functional. It can help to shape optimal development of water resources and to take into account as nearly as possible the rights and wishes of the local people. It can also act as a needed counterbalance to governmental bureaucracies. When opposition from bungling through inept interpersonal relations or from lies and half-truths of individuals or groups with vested interests, it is no longer functional. This dysfunctional opposition is costly in terms of both time and money. (Seneca-Rutgers) W69-02540

#### PLANNING FOR REGIONAL. DEVELOPMENT, THE PACIFIC NORTHWEST, Pacific Northwest River Basins Commission, Vancouver, Wash. Charles W. Hodde.

Proceedings of the Third Annual American Water Resources Conference, 1967, pp 36-43, 8 p.

Descriptors: \*Pacific Northwest U. S., Geographical regions, Idaho, Oregon, Washington, Water Resources Planning Act, \*River Basin Commis-Resources Planning Act, \*River Basin Commissions, Water resources, Planning, \*Water resources development, Governments, Federal government, Wyoming, Montana, Southwest U. S., Columbia River, Water utilization.

Identifiers: \*Pacific Northwest River Basin Commission, Columbia-North Pacific Comprehensive

In this article Charles Hodde, Chairman of the Pacific Northwest River Basin Commission, describes his organization and explains his concept of water resources planning for the region. The Pacific Northwest River Basin Commission was established by Executive Order under the provisions of the Water Resources Planning Act of 1965. The Commission has members representing the states of Idaho, Montana, Oregon, Washington and Wyoming in addition to representatives from several federal departments. There may be an addition of one or two members representing interstate compacts approved by Congress if such compact organizations desire representation. The Commission is charged with the responsibility of developing a long-range comprehensive plan for the preservation, development and best use of its water and related lands. The Commission is not designed to take over the planning of future water projects. Instead it is a coordinating mechanism chiefly interested in a proper relationship of the planning of all entities-federal, state, local and private. The threat of substantial diversion of water from the Columbia River system to the Southwest is a coheof the Southwest is a cone-sive force within the Commission. According to Mr. Hodde, the Pacific Northwest has uses for all its water. (Seneca-Rutgers) W69-02543

#### PLANNING FOR GROUND WATER BASIN MANAGEMENT,

California State Dept. of Water Resources, Sacramento.

For primary bibliographic entry see Field 04B. For abstract, see . W69-02544

## WISCONSIN'S SHORELAND AND FLOOD

PLAIN PROTECTION PROGRAM, Wisconsin Bureau of State Planning, Madison. For primary bibliographic entry see Field 06F. For abstract, see . W69-02550

## BENEFIT-COST ANALYSIS AND EXTERNALITIES IN PRIVATE CHOICE: COMMENT,

Michigan State Univ., East Lansing. Robert A. Solo. Southern Econ Jour, Vol XXXIV, No 4, pp 569-570, April 1968. 2 p.

Descriptors: \*Cost-benefit analysis, Alternative

Identifiers: \*Consumer surplus, Entrepreneurial choice, \*Externalities, Private activity.

There are both external economies and external diseconomies left out ot account by the entrepreneur and both consequent upon entrepreneurial choice. There is not a priori reason to suppose that the economies overbalance the diseconomies or vice versa. Where a proposed project is intended to replace a specific activity in the private sector, e.g. a publicly-owned nuclear reactor for a coalbased generating capacity in private hands, it is just as feasible that the benefit-cost analysis take into account the sacrificed external benefits of the private activity as that it take into account the anticipated benefits of the public project. The public authority is no more likely to take into account the distant and diffused benefits and costs consequent upon the project to which that analysis relates, than it is to take account of the distant and diffused externalities of the activities which it replaces. It, therefore, cannot be assumed that there is a systematic bias built into benefit-cost analysis favoring the public vis-a-vis the private activity. (Seneca-Rutgers) W69-02551

# THE PROCESS OF MAKING GOOD DECISIONS ABOUT THE USE OF THE ENVIRONMENT OF MAN,

Calgary Univ. (Alberta).

Louis Hamill.

Natural Resources Journal, Vol 8, No 2, pp 279-301, April 1968. 23 p, 1 tab.

Descriptors: \*Decision making, \*Methodology, Environment, Forecasting, \*Economics, \*Opera-tions research, Efficiencies, Date collections. Identifiers: Assumptions, Management science, Alternatives, Criteria, Objectives, Programmed decisions, Non-programmed decisions.

There are major objections to the use of economic theory as a basis for making decisions about the use of resources or environments: (1) There is no substantial agreement about which theory is to be used. (2) Economic theory requires all aspects of the problem to be quantifiable. (3) The assumptions are seldom realistic. (4) The results of the theory tend to persist after their usefulness has ended. (5) Economic theory requires a substantial amount of time and evergy to master. Rather than using economic theory, decision makers should use the principles of operations research and management science. Unlike economics, operations research and management science are not primarily interested in developing a body of knowledge; they are far more interested in developing sets of procedures that will produce efficient action. Efficient decision making requires the conscious and explicit consideration of each element of the decision process in an orderly way. The decision process usually is begun by the recognition of a problem. Once the problem is recognized, the alternative courses of action can be identified and the consequences of each action can be forecasted. The next step is to explicitly state the objectives of the decision maker. (Seneca-Rutgers) W69-02552

ECONOMIC PLANNING FOR STAGED DEVELOPMENT,
Harza Engineering Co., Chicago, Ill.
Kenneth E. Sorensen, and Robert D. Jackson.
Proc Amer Soc Civ Eng, J Hydraul Div, Vol 94, No
HY5, pp 1231-1244, Sept 1968. 14p, 9 fig, 2 ref, append.

Descriptors: \*Planning, Project planning, Economics, Investigations, \*River basin development, Resource development, Optimum use, Benefits, Optimum development plans, Cost comparisons, Policy matters, Costs, Water costs, Benefit-cost ratios, Water resources, Project feasibility, \*Projects, Capital costs, Investment, Obsolescence, Economic feasibility. Identifiers: \*Staged development.

The economic merits of water projects vary with the opportunities for multistage development. The following factors involving engineering techniques and economic criteria should be considered when planning and evaluating staged developments: (1) investment capital is limited; (2) investment is justified only if beneficial use is achieved within a reasonable time; (3) essential needs must be met by the most economic alternative (in the absence of overriding considerations); and (4) investment in desirable but unessential projects must bring a return commensurate with other investment opportunities. Each of these factors is discussed. So that the water resources planner may realistically evaluate the economic merits of water projects, various reasons for staged development, types thereof, economic factors, and contemporary analytic procedures are presented with examples of known applicaton. (USBR) W69-02586

## ECONOMIC DERIVATION OF RESERVOIR OPERATING RULES,

Kentucky Univ., Lexington. L. Douglas James.

Proc Amer Soc Civ Eng, J Hydraul Div, Vol 94, No HY5, pp 1217-1230, Sept 1968. 14 p, 4 fig, 7 tab, 10 ref, append.

Descriptors: \*Reservoir operation, Operations, Flood control, Water storage, Multiple purpose reservoirs, Recreation, Water supplies, Economics, Optimum use, Benefits, Policy matters, Simulation, Planning, Streamflow, Streamflow records, Draw-down, Water resources, Water laws, Reservoir storage, Torts.

Identifiers: Rough River Reservoir (Ky), \*Operating criteria.

Reservoir operation requires rules to indicate the amount of water that should be held on a month by month basis throughout the year. In a system of reservoirs, operating rules must also allocate pur-pose-storage space for each reservoir. While exten-sive research has been reported on designing water resource systems for increased economic efficiency, applying economic criteria to the derivation of rules for reservoir operation has received limited attention. Proper design and operation are equally prerequisite to efficient resource utilization. Economic tradeoffs may be used to resolve conflicting storage requirements of flood control, recreation, and water supply in accordance with time changes in demand. Total potential purpose benefits and economic loss functions are determined to derive operating rules for the case study of Rough River Reservoir, Ky. Legal and other practical problems in implementing such rules are described. (USBR) W69-02587

## LINEAR DYNAMIC DECOMPOSITION PRO-GRAMMING OF OPTIMAL LONG RANGE OPERATION OF A MULTIPLE MULTI-PUR-POSE RESERVOIR SYSTEM,

California Univ., Berkeley. Shailendra C. Parikh. Rep, Oper Res Center, ORC 66-28, Univ of Calif, Berkeley, Sept 1966. 25 p, 7 fig, 4 tab, 5 ref.

Descriptors: \*Linear programming, \*Dynamic programming, \*Reservoir operation, Reservoir storage, \*Long-term planning, \*Multiple-purpose reservoirs, Optimization, Monthly, Mathematical models, Digital computers, Constraints, Decision making, Electric power demand, Water demand. Identifiers: Decomposition principal, North California.

The decomposition principle of linear programming was used together with dynamic programming to obtain optimum long range releases and firm power and water commitments, for two actual reservoir systems in Northern California. The mathematical model, using deterministic inflows, combined the dynamic programming approach applied to a single reservoir with the decomposition principle of linear programs to interconnect all the reservoirs. Physical constraints (e.g., maximum and minimum reservoir and generating capacities) were established for 2 reservoir-24 month and 4 reservoir-36 month models. from Northern California reservoir data and 1926-28 hydrology. The constraint set was proved to be not convex, but the effect of the nonconvexity was found to be not significant. The program was written for the IBM 7094. Computer times and results were tabled. It was found that optimal values of firm water and firm energy were reached after relatively few iterations of the program. (Gysi-Cornell)

#### WHAT HAPPENED TO MULTIPLE PURPOSE RESOURCE DEVELOPMENT. -- A PLEA FOR REASONABLENESS,

Wyoming Univ., Laramie, Coll. of Law. Raphael J. Moses. Land and Water L Rev, Vol 3, No 1, pp 435-441, 1968. 7 p, 22 ref.

Descriptors: \*Multiple-purpose projects, \*Water resources development, Recreation, \*Conservation, Reservoirs, Dams, Impoundments, Land management, Project purposes, \*Preservation, Legal aspects.

The author criticizes the result reached in several recent cases which reject multiple-purpose projects in the name of conservation and protection of scenic areas. These projects, which provide widespread recreational facilities, are another kind of conservation and should be looked upon reasonably in comparison with mere preservation of natural conditions. Several recent cases are discussed, and note is made of the fact that the nolice power has been held to authorize legislative measures aimed at preserving natural beauty. The argument that asthetic considerations should receive at least as much stress as large scale resource development is receiving widespread accentance. There must be a balance struck between these two objectives of resource development. The wood industry is discussed as an example of resource development coupled with conservation techniques. A possible initial step in finding the answer to the perplexing value question of whether to develop or preserve is the establishment of a large group or agency to focus upon and delineate the issues. At any rate, a balance should be maintained between these two alternatives -- development and preservation. (Williams-Florida) W69-02696

## THE SOCIOLOGIC AND ECONOMIC ASPECTS OF WATER RESOURCES AND WATER RESOURCES PLANNING IN GEORGIA,

Georgia State Planning Bureau, Atlanta.
Ronald M. North, and Stephen J. Brannen. Georgia Univ. Dept. of Agr. Eco., College of Agr., Inst. of Community and Area Devel, Special Report. University of Ga., pp 1-50, May 30, 1968, 3 maps, 2 fig, 11 ref.

Descriptors: \*Social aspects, \*Planning, \*Resource development, \*Census, \*History, Inland water-

In the first section, the sociological aspects of Georgia, both in the past and present, are discussed. Both the present water transportation facilities and the current population densities by county are presented with maps. The next section examines in detail the appropriate planning process for Georgia. A basic overall plan and objectives are listed. The third section discusses the objectives and strategies of the Georgia water resources plan. The appropriate process of inventorying for water resources development in Georgia is the topic of the fourth section. The fifth section lists which resources should be inventoried. The last section states strategies for water resources planning. A summary and bibliography are also included. (Grossman-Rutgers) W69-02774

## ECONOMIC BASE STUDIES IN RESOURCE

ADMINISTRATION,
Paul W. Barkley, and Thaine H. Allison, Jr. Land Economics, Vol 44, No 4, pp 470-479, Nov 1968. 10 p, 20 ref.

Descriptors: \*Water resources development, \*Governments, \*Project planning. Identifiers: \*Economics, \*Base studies, \*Resource administration

Originally, the economic base study was used as a means of ascertaining growth potential and growth patterns for municipal areas. In the development of natural resources, the economic base study has been called upon to perform functions for which it is not well suited. The interest of Federal natural resource developing agencies have broadened to include the impact of whole sets of projects on various sectors of the economy. Base studies have presented discussions of the results of growth or have estimated the likely results of potential growth but have not come to grips with the essential questions of the causes of growth. The develop-ment of approaches that will determine the cause of growth needed. Three reports by Federal water resource developing agencies are examined and their short-comings are discussed. Further, some recommendations regarding the use of basic or comprehensive studies in natural resource planning are made. (Grossman-Rutgers) W69-02/75

#### ON THE TREATMENT OF INCOMMENSURA-BLES IN COST-BENEFIT ANALYSIS,

Wisconsin Univ., Madison. Dept. of Economics.

John E. Brandl.

Land Economics, Vol 44, No 4, pp 523-525, Nov 1968, 3 p, 1 fig, 2 ref.

Descriptors: Recreation, Water re-use, \*Mathematical studies.

Identifiers: Economics, \*Cost-benefit theory, \*Incommensurables.

Incommensurable goods are those goods for which no common measure of value, such as dollars, exist. Cost-benefit analysis can be defined as the maximization of an objective function relating outputs of programs, subject to the production function or cost-effectiveness constraints to inputs subject to a limited budget. The transformation curve between recreational water reclamation is examined to shed light on the theory of cost-benefit analysis. The mathematical and logical argument for utilizing incommensurables are included. (Grossman-Rutgers) W69-02776

### AN ANALYSIS OF RECREATIONAL USE OF THE TVA LAKES, Joseph J. Seneca, Paul Davidson, and Gerard F.

Land Economics, Vol 44, No 4, pp 529-534, Nov 1968. 6 p, 1 fig, 5 ref.

Descriptors: \*Time series analysis, \*Water supply, \*Recreation demand.
Identifiers: Economics, \*Mathematical studies.

The development and utilization of recreation facilities over time are examined. The Tennessee Valley Authority Lakes serve as the source of data for this study. The analysis is separated into two parts, a theoretical section and an aggregate time series study. The theoretical section examines the difference between the structural demand and supply equations and the reduced form. The empirical section shows that the changes in the area of recreational water available have a greater effect on water-oriented recreational activity than changes in the supply of ancillary facilities. (Grossman-Rutgers) W69-02777

### Group 6B - Evaluation Process

ESTHETIC AND RECREATIONAL POTENTIAL OF SMALL NATURALISTIC STREAMS NEAR

OF SMALL NATURALISTIC STREAMS NEAR URBAN AREAS, Kentucky Univ., Lexington. Water Resources Inst. John A. Dearinger. Water Resources Institute, University of Kentucky, Research Report No. 13, 1968. 260 p, 34 illus, 38 tab, 2 appen, 82 ref. OWRR Project A-010-Ky.

Descriptors: \*Methodology, Evaluation, \*Terrain analysis, Land use, Project planning, \*Outdoor recreation, Aesthetic, Pyschological aspects, Social values, Attitudes, Behavior, Social aspects, Scenery, Aerial photography, Water quality, Wildlife Percention demand dlife, Recreation demand.

Identifiers: Boone Creek, Jessamine Creek, Kentucky, Potential.

The purpose of the study is to develop a method of evaluating the esthetic and recreational potential of small streams and their watersheds. The proposed method emphasizes the use of all available sources of information about the stream and its watershed, and is based on the principles of terrain analysis and land use planning, quantitative geomorphology, airphoto interpretation, the philosophy and psychology of value judgments and the economics of land use and outdoor recreation. Boon and Jessian description is to be a superior of land use and outdoor recreation. samine Creeks are the test cases in using the proposed method. The methodology contains two phases: (1) the inventory phase, and (2) analysis and evaluation phase. Scenic and recreational factors are enumerated and attempts made to evaluate them. Conclusions are: (1) esthetic and recreational values can be identified, inventoried, and used to evaluate a watersheds development potenused to evaluate a watersneds development poten-tial, (2) methodology was fairly accurate; and (3) case studies revealed that many small stream areas possess considerable potential for many forms of esthetic enjoyment. (Gargola-Chicago) W69-02780

## WATER MANAGEMENT IN CENTRAL AND SOUTHERN FLORIDA, Central and Southern Florida Flood Control Dis-

For primary bibliographic entry see Field 06F. For abstract, see . W69-02800

#### 6C. Cost Allocation. Cost Sharing. Pricing/Repayment

## ROSBOROUGH V CITY OF MOLINE (WATER DISTRIBUTION APPLIED).

30 Ill App 2d 167, 174 NE 2d 16-24 (1961).

Descriptors: \*Illinois, Cities, \*Legislation, Water law, Water rates, Utilities, Water users, Water costs, \*Local governments, Legal aspects, \*Public utilities, Water works, Water distribution (Applied), Facilities, Pipes, Distribution systems, Water supply, Judicial decisions, Conduits, Domestic water.

The issue in this case is whether, under the relevant Ill statutes, the cost of repair and replacement of a water service pipe running from a water main in the city street to the abutting property of the plaintiff is chargeable to plaintiff or to the defendant City of Moline. Under the relevant statutes the defendant had the power to make all needed rules and regulations. The rules are a part of the contract with the plaintiff, and every consumer, and under such rules. plaintiff, and every consumer, and under such rules all service pipes and fixtures must be installed, maintained, and repaired at the expense of the promaintained, and repaired at the expense of the pre-perty owners. The regular water rates of the defen-dant do not anticipate or include a charge for the installation or repair of service pipes from the main to the curb. The court held the rules in question to be reasonable, just and fair. They do not appear to be oppressive, contrary to law, or contrary to any public policy expressed by the legislature. (Smith-Fla) W69-02443

FINANCING THE RECREATIONAL USE OF

IMPOUNDED WATER,
California State Dept. of Natural Resources. J. Delbert Sarber, and Elmer C. Aldrich.

Proceedings-Conference on Recreational Use of Impounded Water, issued by Committee on Research in Water Resources, University of California, pp 50-58, December 1956. 9 p, disc.

Descriptors: California, \*Financing, \*Impounded waters, Reservoirs, \*Recreation facilities, Capital costs, Management, Administration. Identifiers: \*Public agencies.

Ownership, operation, purpose of the impounded water, nature of reservoir operation, and the extent of the recreational area which may be acquired, can be seen to give some indication of the size of the financing problem. An added cost factor is found in the amount of planning and programming activity which must precede the establishment of a reservoir recreation facility. Currently being discussed is the question of which agency ought properly to undertake the development of recreational areas at which level. Public pressure at the present time, logically or not, is probably the only instrument which will at least determine which agency or agencies will undertake the task of financing a recreational facility on a reservoir at a given location. Water recreation facilities are more costly initially than others though they lend themselves later to fee charges. A part of the initial cost of a project is that of 'developing' the land for public use. Normally, such developments will be carried forward by stages and the financing load will not be felt all at once. (Seneca-Rutgers) W69-02525

## THE NEW BULK SUPPLY TARIFF FOR ELEC-TRICITY, Leicester Univ. (England).

Ronald L. Meek. Econ Jour, Vol LXXVIII, No 309, pp 43-66, March 1968. 24 p, 4 fig, 1 tab, 1 chart.

Descriptors: \*Electric power rates, Technology, \*Peaking capacities, Welfare. Identifiers: \*Base capacities, Area Boards, Rate differentiation, \*Bulk supply tariff, \*Boiteux-Steiner model, Capacity cost.

The Central Electricity Generating Board recently Ine Central Electricity Generating Board recently announced details of a new Bulk Supply Tariff for electricity supplied to Area Boards. The appearance of this tariff is an event of some significance in the history of public authority pricing in the U.K., since both the running charges and the capacity charges are henceforth to be based on 'marginal principles'. The present paper deals first with the concrete details of the new reform, considering them within the context of a brief history of the tariff from nationalization to the present time. It then presents a theoretical structure (based on a development of the traditional Boiteux-Steiner peak-load pricing model) in terms of which the general validity of the new tariff may be assessed. It is concluded that the tariff, whether it can be said actually to involve 'marginal cost pricing' or not, will at any rate tend to achieve the general aim which would be - the maximisation of the sum of which would be - the maximisation of the sum of producers' and consumers' surpluses, subject to the constraint that total system costs are covered. The limitations of this analysis, as well as the 'equitability' of the new tariff and its possible effects on the retail tariffs charged by the Area Boards, are briefly discussed. (Seneca-Rutgers)
W69-02531

#### ASYMMETRY BETWEEN BRIBES AND CHARGES.

Carnegie Inst. of Tech., Pittsburgh, Pa. For primary bibliographic entry see Field 05B. For abstract, see. W69-02534

ANALYSIS OF THE CONSTANCY OF THE EF-FECTIVE TAX RATE. Brookings Institution, Washington, D. C.

Terence J. Wales.

Rev Econ and Stat, Vol XLX, No 1, pp 103-110, Feb 1968. 8 p, 2 tab, 1 append.

Descriptors: Tax rate, Taxes, Progressive taxes. Identifiers: \*Effective tax rate, \*Constancy, Taxable income, Taxable income growth, Marginal tax rate, Adjusted gross income.

The ratio of taxes to taxable income on individual returns remained approximately constant at 23.4 percent from 1955 to 1962, while taxable income increased more than 50 percent. Since the income tax structure is progressive, constancy of the effective tax rate seems at first glance to be a strange result. It is the purpose of this paper to show that such constancy is, in fact, not surprising. Even with proportional taxable income growth (across in-dividuals) equivalent to nonproportional growth in recent years effective tax rate changes are not large. Further, there are good reasons for expecting taxable income growth to be nonproportional. First, proportional growth of adjusted gross income is a more realistic assumption than proportional growth of taxable income. Second, the annual dis-tribution of new taxpayers probably differs from the distribution of existing taxpayers. Third, the growth in deductions and exemptions differs for various income levels. All three of these factors cause taxable income growth to be greater at low than high income levels, thus enhancing the importance of low marginal tax rates. This tends to moderate or prevent the increase in the effective rate that would result from the movement of returns to higher brackets. (Seneca-Rutgers) W69-02546

## AN EMPIRICAL DETERMINATION OF A DYNAMIC UTILITY FUNCTION,

Harvard Univ., Cambridge, Mass. Koichi Mera.

Rev Econ and Stat, Vol XLX, No 1, pp 117-122, Feb 1968. 6 p, 3 fig, 3 tab, 6 ref.

Descriptors: Marginal utility, Growth rates, Discount rate, United States, National income, Capital, Regression analysis.
Identifiers: \*Dynamic utility function, Elasticity of

marginal utility, Personal consumption, Optimal growth, Japan, Canada.

An intertemporal optimization condition follows from any model of optimal growth. Such an equation usually contains two parameters which cannot be directly observed: the discount rate of future utility and the elasticity of marginal utility. These utility and the elasticity of marginal utility. These two parameters can be empirically estimated if they remain constant over time and if the assumed criterion function is maximized in the real economic system. In this paper a method of estimating these two parameters is presented and it is applied to the United States, Japan, and Canada. Although the results are not conclusive, in view of the assumptions involved, they tend to confirm the hypothesis that they are fairly stable over time, at least during a sociologically well-defined short period. (Seneca-Rutgers) period. (Seneca-Rutgers) W69-02547

## NOTE ON THE ASYMMETRY BETWEEN

FEES AND PAYMENTS,
Johns Hopkins Univ., Baltimore, Md.
David F. Bramhall, and Edwin S. Mills.
Water Resources Research, Vol 3, No 3, p 615-6,
Third Quarter 1966. 2 p, 2 ref.

Descriptors: \*Payment, \*Pollution abatement, Waste disposal, \*Administration. Identifiers: \*Fees, Effluent payments.

In his book The Economics of Regional Water Quality Management, Kneese compares the use of fees and payments to induce the abatement of waste discharges to bodies of water. The choice is between a fee that depends upon the amount of waste discharged and a payment that depends upon the amount by which waste discharges are less than they would otherwise have been. Kneese states that

#### Water Demand — Group 6D

the payment plan has many administrative difficul-ties (such as the determination of what discharges would have been in the absence of a payment scheme). However, Kneese concludes that in theory the choice between fees and payments is one of equity and not efficiency. In this article Bramhall and Mills question Kneese's conclusion. They contend that under the payment scheme profit will be larger than they would have been in the absence of intervention and under a fee scheme profits will be smaller than they would have been in he absence of intervention in the long run. On the usual assumptions about entry and exit, entry will ake place in the former case and exit in the latter. Entry will lower the price of this product relative to other products and exit will raise it. Thus, in the ong run relative prices will be different under a payment scheme than under the charge scheme. Seneca-Rutgers) W69-02553

UNBALANCED BIDDING MODELS-THEORY,

Delaware Univ., Newark.

For primary bibliographic entry see Field 06A.
For abstract, see . W69-02602

WATER WELL CONTRACTOR'S LICENSE

ACT.
For primary bibliographic entry see Field 04B.
For abstract, see . W69-02633

WOODSIDE HOMES, INC V TOWN OF MOR-RISTOWN (COSTS OF EXTENSION OF WATER MAINS).

For primary bibliographic entry see Field 06E.
For abstract, see .
W69-02718

#### 6D. Water Demand

THE MARKET FOR WATER BASED OUT-DOOR RECREATION SERVICES IN NEW CAS-TLE COUNTY, DELAWARE, Delaware Univ., Newark. Dept. of Economics.

Research Project Partial Technical Completion Report to Office of Water Resources Research, Department of the Interior, Washington, D. C., November 1, 1968. 3 p. OWRR Project A-003-Del.

Descriptors: \*Water-based outdoor recreation, Water quality, \*Demand, \*Supply, Cost structure, thort-run costs, Long-run costs, \*Projections,

The demand for water-related recreation in an outloor setting and the available supply are analyzed or the purpose of providing more precise informa-ion in a well-defined framework to facilitate deciionmaking. The framework is useful for decision-naking at the local level elsewhere, as well as New castle County. A definition of the demand for, and upply of, such recreational activities is developed with the aid of economic theory. Briefly, quantities lemanded and supplied are taken as a function of rice, but there are parameters such as population, rice, but there are parameters such as population, amily income, age-sex pattern, race and place of esidence which determine the level of demand-conomic theory regarding the short-run and long-un behavior of costs is used to show that (1) unterutilization or overutilization of a given sized acility can raise unit cost, (2) increasing size and apacity can reduce unit cost but (3) after a certain ize is reached, it may be cheaper to develop nother facility instead of expanding the capacity of the existing one. When demand for, and the upply of, such recreational facilities is measured, he supply in New Castle County at the present evel of prices appears deficient. Substantial traveletween the county and contingent recreation reas, the failure to meet certain national recreation standards and the obvious pressure on county on standards and the obvious pressure on county acilities also support the conclusion. Furthermore,

demand projections indicate an increasingly severe shortage in the absence of major expenditures. The advisability of making them involves assessing the innumerable benefits to consumers.

## PRESERVATION VALUES IN RIVER BASIN PLANNING, Izaak Walton League of America.

Roger Tippy. Natural Resources Journal, Vol 8, No 2, pp 259-278, April 1968. 20 p, 2 tab.

Descriptors: \*Planning, \*River basin development, Decision making, \*Preservation, Political aspects, Federal government, \*Administrative agencies, Oregon, Judicial decisions, Permits, Wild rivers, Legislation, Missouri River, Montana.

Identifiers: \*Army Corps of Engineers, \*Federal Power Commission, Department of the Interior, Bureau of Reclamation, Rogue River Basin.

There are conflicts between development-conservationists and preservation-conservationists. These conflicts will increase because while an appreciation of the preservation values is rising, the demand for the benefits of water resource development is rising just as rapidly. Planning should illuminate all the values involved so that decisions to develop are made after consideration of the preservation values which will be lost, and so that decisions to preserve are made with an awareness of the development values foregone. Ideally, a river basin should have some areas suitable for preservation goals and other regions suitable for development goals. A competent planning unit could identify each of these areas and enable the decision makers to satisfy every interest group in the basin. In practice planning often seems to generate conflicts rather than resolve them. For such conflicts, two forms of resolution are available. Either the planners can present the decision makers a choice of alternatives or the planners can compromise the several values and present the decision-makers with a single answer which hopefully does not dissatisfy one interest group more than the others. (Seneca-Rutgers) W69-02529

## THE DEMAND FOR INLAND WATERWAY TRANSPORTATION,

Purdue Univ., Lafayette, Ind. For primary bibliographic entry see Field 06A. For abstract, see . W69-02535

# SOME CONCEPTUAL PROBLEMS OF INTERPRETING THE VALUE OF WATER IN HUMID REGIONS,

Johns Hopkins Univ., Baltimore, Md.

Sherry Hessler Olson.
Water Resources Research, Vol 2, No 1, pp 1-11, First Ouarter 1966. 11 p. 7 fig. 20 ref.

Descriptors: \*Water values, \*Humid areas, Water utilization, Return, Irrigation systems, Water costs,

Productivity, Geographical regions, Recirculated water, Water distribution, Industrial water. Identifiers: \*Marginal value, \*Depleting uses, \*Nondepleting uses, Bethlehem Steel Company, Marginal revenue, Enler's theorem.

Procedures for calculating returns per acre-foot of water were developed in western United States irrigation projects and have been applied to supplemental irrigation in the humid eastern areas. Th procedures constitute an operational definition of a marginal product of water, but the definition rests on a different theoretical basis in the two cases and does not apply to intermediate conditions. No general notion of marginal revenue of water appears meaningful for manufacturing uses, which are largely nondepleting. Comparisons made between the value of water in farming and in indus-trial uses are of doubtful value, particularly if they are extended to the humid regions. A method is proposed for estimating the 'marginal value' of water intake in manufacturing. The method is based on the cost of the internal economy of water in an industrial plant. It may be used to compare the relative productivity of water in depleting and nondepleting uses, or to compare the returns to industry with the costs of public development of a water supply. Some estimates of marginal value are derived from data supplied by the Bethlehem Steel Company plant at Sparrows Point, Maryland. (Seneca-Rutgers)
W69-02536

#### GROUNDWATER MANAGEMENT UNDER QUADRATIC CRITERION FUNCTIONS,

Missouri Univ., Columbia. Dept. of Agricultural

For primary bibliographic entry see Field 04B. For abstract, see . W69-02537

#### DYNAMIC ECONOMIC EFFICIENCY WATER QUALITY STANDARDS OF CHARGES,

Washington Univ., Seattle. For primary bibliographic entry see Field 05D. For abstract, see . W69-02549

### A RECONNAISSANCE STUDY OF THE CHES-APEAKE BAY, Department of Housing and Urban Development,

Washington, D. C. Paul R. Farragut.

Regional Planning Council, Baltimore, Maryland, 1968, 114 pp, 6 fig, 2 append, 25 ref.

Descriptors: Water resource management, Project planning, Formulation, \*Future planning, Water quality control, Thermal pollution, Stream standards, Sate governments, Administrative agencies, Jurisdiction, Land use, Flood damage, Erosion, Sedimentation, \*State jurisdiction.

Identifiers: Baltimore (Maryland), Chesapeake Bay, Susquehanna River.

The report discussed present and future problems involved the region's shoreline attempting to synthesize many of the narrowly focused technical studies completed in the past. Physical problems, such as erosion, sedimentation, tidal flooding, and water characteristics, such as excessive nutrients, polluted shellfish areas, thermal pollution, plant and animal nuisances and the importance of the wetlands and the Susquehanna River are considered. A chapter on water quality contrasts the present condition of streams with the highest protected use as defined by the state's water qualities standards. State appearies having resonabilities standards. State agencies having responsibilities relating to the bay resources are identified. The jurisdiction and extent of their involvement in specific problems is considered. An attempt is made to recognize the many important interrela-tionships existing along the bay shoreline at the interface of land at water. Present water quality standards designate 'zones' of water quality in different areas which exert an influence on land use. The entire study focuses on the water resource of the Chesapeake Bay in an attempt to facilitate accurate and complete waterfront planning. (Gargola-Chicago) W69-02771

VERMILION RIVER BASIN STUDY, Illinois State Div. of Waterways, Springfield. Bruce Barker, John B. Carlisle, and Raymond

Nyberg. Illinois, Public Works and Buildings Dept., Springfield, Ill. 1967, 20 tab, 22 fig, 99 pp.

Descriptors: \*River basin development, Administrative agencies, Hydrologic data, Water supply, Water quality, Recreation, Flood damage, Water resource management, Drainage districts, Irrigation, Project planning, \*Adoption of practices,

#### Group 6D-Water Demand

Waste water treatment, \*Water quality control, Flood control, Municipal water supply. Identifiers: Wabash Basin, Vermilion Basin.

Certain problems - poor natural drainage, in-adequate low flows, limited supply of potential water storage sites and a shortage of natural forests, scenic lands and waters for outdoor recreation -are discussed in relation to the physical geography of the area. Outlined are the economic aspects of agriculture and industry in the basin. Pertinent hydrologic data is stated so that meaningful estimates can be made of the quantities of water available in surface streams or groundwater aquifers, and the frequency of drought, floods and rainstorms. The possibility of wastewater treatment facilities for attainment of stream quality standards is investigated. Four points of stream quality requirements are enumerated, but it is noted that additional criteria are necessary for the protection and maintenance of a fish population. Potential sources of water supply -- groundwater, surface water, well water -- are suggested to meet the future increased demand for water. Significant factors in drainage are considered within discussion of the flood problem. It is recommended that local governments carry out flood damage reduction plans rather than state or federal agencies. In conclusion, the study indicates that the water resources of the Vermilion Basin have been wisely developed and well managed up to the present and the work need only continue. (Gargola-Chicago) W69-02772

KANKAKEE RIVER BASIN STUDY,

Illinois State Bureau of Water Resources, Springfield.

Bruce Barker, John B. Carlisle, and Raymond Nyberg.

Illinois Bureau of Water Resources, 1967, 76 pp, 39 fig, 27 tab, 65 ref.

Descriptors: \*River basin development, Administrative agencies, Drainage, Flood control, Municipal water supply, Hydrologic data, \*Water quality control, Stream quality, Irrigation, Project planning, \*Adoption of practices, Recreation, Public benefits, \*Water resource management, Drainage districts, Wastewater treatment, Project purposes

purposes. Identifiers: Kankakee River Basin, Iroquois River,

The study includes discussion of all major aspects of water use and management which will be affected by changing conditions in the future. Considered are population growth, municipal water demand, water quality control, water-oriented recreation, flood damage control, agricultural drainage, and irrigation. Certain recommendations are made from the findings relating to these factors: (1) water supplies for the anticipated urban fringe area in the northeast portion of the basin can be obtained from shallow dolomite aquifers providing wells are properly constructed, developed, and spaced; (2) the natural water quality in the basin is good and can be maintained by adequate treatment of municipal and industrial wastes; (3) the Kankakee and Iroquois rivers should be developed as recreational waterways to accommodate pleasure boating, fishing and related activities; and (4) flood damage control through land use management in all areas of the basin subject to urbanization and construction of a levee to protect the developed area of Watseka is recommended. The major demands on the water resources of the Kankakee basin will occur from the expansion of industry and urban population. These demands can be met through implementation of the above suggestions, and insure continued economic growth. W69-02773

THE SOCIOLOGIC AND ECONOMIC ASPECTS OF WATER RESOURCES AND WATER RESOURCES PLANNING IN GEORGIA, Georgia State Planning Bureau, Atlanta. For primary bibliographic entry see Field 06B. For abstract, see.

W69-02774

PLANNING FOR WATER RESOURCE MANAGEMENT IN ARLINGTON HEIGHTS, IL-LINOIS,

Arlington Heights, Ill. John R. Sheaffer, James E. Hackett, Emil Oelberg, and George Davis. Wheaton, Ill., 1967, 36 pp, 15 fig.

Descriptors: \*Water resource management, Political constraints, \*Project planning, Future planning, \*Local governments, Community development, Storm runoff, Floodwater, Typography, Aquifers, Groundwater, Surface water, Recreation, \*Water quality control.

Identifiers: Arlington Heights, Weller Creek, McDonald Creek, Tinley Moraine.

The foundation of a resource management program is the physical setting. This serves to define the potential for water resource management and assists in the establishment of the range of development possibilities. The physical setting of Arlington Heights, Illinois is explored. The topography, distribution of materials, sands and gravels, ground and surface water resources are outlined. Management considerations resulting from these particular physical settings are discussed and certain sug-gestions put forth. Five special project areas, designated as focal points for water resource management are considered: (1) solid waste and recreation site south of Nichols Road, (2) area west of Tinley Moraine adjacent to Salt Creek, (3) industrial zone south of Dundee Road, (4) McDonald Creek Parkway Development, and (5) Weller Creek north of Central Road. In conclusion, nine recommendations are made for future water resource management in the area and for special projects. Recent policy statement by the Metropolitan Sanitary District of Greater Chicago will greatly affect surface water management in Arlington Heights; the ramification of this are outlined. (Gargola-Chicago) W69-02778

LITTLE CALUMET RIVER STUDY,

Lake Michigan Region Planning Council, Inc., Chicago, Ill. George N. Hall, and Richard W. Cramer. Lake Michigan Region Planning Council, Project 66-1, 1968, 71 p, 1 map, 9 illus, 20 fig, 27 ref.

Descriptors: \*River basin development, \*Regional planning, Urbanization, City planning, Flood plain zoning, Local governments, Project planning, Recreation demand, Social needs, Water quality, Flood control, \*Project purposes, Future planning, \*Community development, Land uses, Administrative agencies, Future planning, Formulation. Identifiers: Little Calumet River, Hammond (Indiana), Historical development, Urban corridor.

The study has been conducted with certain goals and policies in mind: (1) constant consideration of the interrelationship between significant factors, (2) environmental preservation and enhancement, and (3) transformation of the river related region to a productive environment. The regions natural characteristics, formations, and resources are explored with discussion of the regions previous human development and present circumstances. The region is aesthetically and physically unattractive due to considerable air and water pollution. The responsibility for this situation lies basically with the local governments and citizens living in the area. A major problem is the lack of adequate recreation and park space closely related to urban housing and activity areas. Improvement of the urban corridor is dealt with, in design analysis and planning considerations. Flood control and water quality problems and suggested solutions are reviewed. The most important consideration in dealing with this situation is that the potential of the area be realized and not hampered by narrow single purpose projects. Various planning concepts, the river park concept, the scenic way concept, and the regional city concept are outlined and dia-

grammed. Design possibilities for certain areas area put forth and suggestions made for their implementation. (Gargola-Chicago)
W69-0779

## 6E. Water Law and Institutions

DRAINAGE BY COUNTIES.

Fla Stat Sec 157 (1967).

Descriptors: \*Canals, \*Conduits, Culverts, \*Drainage systems, Maintenance, Assessments, Bids, Construction costs, Condemnation value, Taxes, Legislation.

Section 157.01 permits that a majority of those owning land through which a ditch or canal might flow to petition the county commission for the purpose of making said ditch or canal a public ditch, drain or canal. Section 157.02 permits the county commission to grant the request of the petition at its discretion. Section 157.03 provides for the appointment of three freeholders to obtain bids for the establishing of the public waterway. Section 157.04 requires that contractor working on the drainage ditch give a performance bond. Section 157.05 states that the work should be done under the supervision of the committee of three freeholders. Section 157.06 provides for tax assessments on the property adjacent to the drainage ditch, and also stipulates that the committee shall view the land before the work begins. Section 157.10 provides that the provisions of the entire chapter shall apply to lateral ditches and drains that may become necessary or expedient for the drainage of adjacent land. Section 157.11 provides for the widening or deepening of any lateral ditch upon the petition of one-fourth of the adjacent landowners. Section 157.16 provides for the assessment against the benefiting landowners for the costs of enlarging or deepening drains or auxiliaries. Section 157.17 provides for assessments to maintain the drains and costion 157.19 provides for assessments to maintain the drains and section 157.19 provides that if the costs exceed estimates, the excess shall be assessed against the landowners. (Dann-Fla) W69-02412

AN ACT TO ENCOURAGE LANDOWNERS TO MAKE LAND AND WATER AVAILABLE TO THE PUBLIC BY LIMITING LIABILITY IN CONNECTION THEREWITH.
lowa Laws Ch H 151 (1967).

Descriptors: \*lowa, Land tenure, \*Land, Marshes, Grasslands, \*Watercourses, Water, \*Recreation, Fishing, Skiing, Boating, Public benefits, Prices, Safety, Hazards, State governments, Administrative agencies, Legislation.

Identifiers: Limited liability, Attractive nuisance.

Iowa, by statute, has limited the liability of private owners of land and water areas to persons coming upon such land for public recreational purposes in order to encourage such owners to make their property available for public recreational purposes. The term 'land', as used in the Act, includes marshlands, water, and watercourses. 'Recreational purpose' has a broad scope including hunting, fishing, swimming, camping, and winter sports. The owner of such private land owes no duty, to persons entering for recreational purposes to keep such premises safe or to warn of a dangerous conition or structure on such premises. Additionally, if he permits, without charge, any person to use his property for such purposes, he does not warrant that the premises are safe for any purpose, conferthe legal status of invitee or licensee upon such person, or assume responsibility for any injury to that person or his property. The Act, however, in no way limits his liability for willful or malicious failure to guard or warn against a dangerous condition or structure or for injury suffered where he charges the person entering upon his land for recreational purposes. (Geraghty-Fla) W69-02413

#### Water Law and Institutions — Group 6E

## WATER AND WATER RIGHTS - WATER POL-LUTION AND QUALITY CONTROLS, For primary bibliographic entry see Field 05G.

For abstract, see . W69-02414

#### LABBADIN V BAILEY (WATER LEVEL).

147 Conn 82; 157 A 2d 237-241 (1959).

Descriptors: Judicial decisions, Legal aspects, \*Connecticut, Riparian land, Water rights, Prescriptive rights, Water level, \*Riparian water loss, Lakes, Dams, Maintenance, Operation and Maintenance.

Identifiers: Deed covenants, Artificial lakes. Private dams.

Plaintiffs and defendants received title to their land, which abbutted an artificial lake, from a common grantor. A dam situated on defendants' land impounded the waters of the lake. The deed from the grantor to the plaintiffs provided that the grantor, or his successors would maintain the dam at its present level and keep it in good repair. The plaintiffs sought an injunction and damages for depreciation in the value of their properties caused by defendants' release of water through the dam. The court, assuming arguendo that the provisions in the deed constituted a convenant running with the land, held that a release of water which did not lower the level of the dam but did lower the level of the lake was not a breach of the covenant. Plaintiffs cannot compel the defendants to repair and maintain the dam on the basis of prescriptive rights acquired through the use of the lake in the absence of an express agreement to do so. (Molica-Fla) W69-02428

### WEISS V BOARD OF COMMISSIONERS FOR PONTCHARTRAIN LEVEE DIST (OWNERSHIP OF SHORE LANDS).

115 So 2d 804-808 (1959).

Descriptors: \*Louisiana, \*Shores, Lake shores, Public rights, Levees, Ownership of beds, Legal aspects, Judicial decisions, \*Eminent domain, Rivers, Market value, \*Property value, Lakes, High water mark.
Identifiers: Servitude, \*Lake Pontchartrain.

This action involved lands appropriated by defendant Levee District to construct a levee on Lake Pontchartrain. The defendant questioned the validity of the plaintiff's title claiming that the property was sea shore and therefore not susceptible of private ownership under the Civil Code. Under the code, a servitude is imposed for the public utility on shores of navigable waters. The court held that the lands were not burdened with the servitude because they did not border or rim the lake but lay behind a highway which formed a protecting levee therefor and prevented inundation except during severe storms, and no portion was closer to the lake's shoreline than 200 feet. (Horner-Fla) W69-02435

#### BRIDGES V THOMAS (STREAM AS A BOUN-DARY).

118 So 2d 549-553 (1960).

Descriptors: \*Real property, \*Boundaries (Property), Riparian land, Legal aspects, Water courses (Legal), Judicial decisions, Natural streams. Identifiers: \*Courses and distances.

Plaintiff sold certain property to defendant without surveying it. The parcel was described as being bounded by a creek which was estimated to be 148 feet north of the south boundary. A subsequent survey showed that the creek was actually 198 feet north of the south boundary. The plaintiff sued to have the deed reformed to reduce the quantity of land so that the boundary would be 148 feet north of the south boundary rather than at the creek. The court held that natural landmarks as a general rule prevail over courses and distances for the purpose of determining the location of a boundary even though this means either the shortening or lengthening of distance. If marked trees or water courses be called for in the deed, distances must be lengthened or shortened and courses varied so as to conform to those objects. (Horner-Fla) W69-02436

#### TENNESSEE GAS TRANSMISSION COMPANY V STATE (RIVER BEDS).

335 SW 2d 312-315 (1960).

Descriptors: \*Mississippi River, River beds, Water rights, \*Federal-state water rights conflicts, \*State jurisdiction, Arkansas, Navigable waters, \*Ownership of beds, State government, Administrative agencies, Permits, Reservation doctrine. Oil industry, Natural gas, Rivers and Harbors Act, Judicial

Identifiers: Natural Gas Act, Federal Power Com-

Several gas companies laid pipelines carrying natural gas underneath the bed of the Mississippi River believing they had obtained proper authorization. In this suit, involving the interpretation of several Federal and Arkansas statutes as well as the common law, the state of Arkansas asked for nominal damages from the gas companies for laying the pipelines under the Mississippi River without the requisite state consent. The court held that the gas companies were liable to the state for nominal damages on several grounds: (1) The states own the beds of navigable waters situated within their boundaries subject only to the paramount rights of Congress to control navigation. (2) Since the state officers granting easements to the gas companies were without the requisite authority to do so, no state assent was obtained. (3) This action brought by the state was not improper as tending to inter-fere with interstate commerce. (4) While the gas companies had the right of eminent domain, they here failed to properly exercise it. (Carruthers-Fla) W69-02437

#### NAIMISH V WAROLOW (RIPARIAN RIGHTS).

362 Mich 198 106 NW 2d 770-774 (1961).

Descriptors: Michigan, \*Riparian rights, Water levels, Water level fluctuations, Inland waterways, \*Lake beds, Drains, Drainage, Farms, Land reclamation, Water rights, Land ownership, Water, Water courses, Judicial decisions.

The defendants were recent purchasers of farm property bordering on Michigan's Duck Lake. Plaintiffs, adjoining landowners with property fronting on the lake, instigated this action to enjoin defendants from attempting to fill a portion of the lake bed in order to gain better access to certain portions of their property. Plaintiffs alleged that such activity cut off access to a bay by which plaintiffs and plaintiffs' predecessors in title had consistently had access to the lake for 34 years. The court held that were the former owners of property adjoining the lake had agreed in 1921 to the construction of a drain which raised the water level of the lake, an action in equitable estoppel was appropriate as against defendants since their activity would interfere with the riparian rights not only of plaintiffs but also of other landowners with property on the lake. (Carruthers-Fla) W69-02441

## APPLICATION AND PETITION OF HUIE. 218 NYS 2d 791-793 (1961).

New York, Descriptors: New York, \*Judicial decisions, \*Diversion, \*Easements, Rights-of-way, Eminent domain, Compensation, Property values, Administrative agencies, Legal aspects. Identifiers: Nonappurtenant right-of-way.

In an eminent domain action, commissioners awarded plaintiff damages for harm to his bungalow business and the taking of his easement when defendant city diverted the river. The commissioners also awarded the respondent Fire District \$5,000 for the decrease in value of its non-riparian land, and \$7,500 for the taking of the district's sixteen foot, nonappurtenant, restricted use right of way to the river. The city appealed the findings. The court affirmed the commissioners' determination that the plaintiff's bungalow colony operation was a business within the meaning of Title K of the Administrative Code of New York City (the Water Supply Act). Damage to the business was compensible, under the act, even though the plaintiff owned no riparian land and merely enjoyed the use of a limited easement to the river. The court declared that the damages fixed as compensation for the decrease in value of the Fire District's land and right of way were greatly excessive. More than vague and unresponsive expert testimony is required when it is suggested that the city compensate an owner for the disparity in his land's market value after diversion of a river, especially when the land allegedly affected is some distance from the river. Very little adequate proof or legal basis supportive of the award made to compensate the Fire District's loss of its peculiar and limited easement was demonstrated. (Blunt-Fla) W69-02445

#### INHABITANTS OF TOWN OF WINTHROP V FOSTER (OWNERSHIP OF UNDERWATER LANDS).

170 A 2d 152-156 (Me 1961).

Descriptors: \*Maine, Judicial decisions, \*Docks, \*Right-of-way, Lake beds, Surveys, \*Ownership of beds, Boundary disputes, Relative rights, Water law, Cities. Identifiers: Injunctions.

Plaintiff town sued for a mandatory injunction obligating the defendant to remove a wharf. The town contended that it owned an easement or fee in the lake bottom. The evidence submitted by the town was confusing and conclusionary in the eyes of the trial judge. The decision at trial was for the defendant, the town appealed, and the Supreme Court of Maine affirmed. This court said that the record did not sustain the town's contention that the trial judge was incorrect in ruling that the town the trial judge was incorrect in ruling that the town had not carried the burden of proof required of it. More than the opinionated testimony of the town engineer, backed by sparse and inconclusive evidence, is required before the town may demand judicial cognizance of its claim of ownership in the face of the undisputed evidence of a long series of wharves which stood uncontested for many years on the same site. (Blunt-Fla) W69-02452

## POTTER V CAROLINA WATER COMPANY (DUTY TO MAINTAIN PRESSURE IN FIRE HYDRANTS).

116 SE 2d 374-380 (NC 1960).

Descriptors: \*Water supply, Hydrants, \*Water pressure, Burning, \*Municipal water, Judicial decisions, Legal aspects.

Plaintiff sued water company to recover for fire damage to plaintiff's property which ascertedly would not have occurred had the defendant water company complied with its contractual duty to the municipality of maintaining water pressure at the hydrant. The court held that this did constitute an actionable breach of contract by the water company. An agreement to provide and maintain the fire hydrants is analogous to the sale of an article by a manufacturer for a particular purpose-to provide fire protection. The article must be reasonably ap-propriate for the purpose for which it is purchased. (Rief-Fla) W69-02453

### Group 6E—Water Law and Institutions

GRANTS OF SWAMP AND OVERFLOWED

43 USCA Secs 981-994, pp 332-376.

Descriptors: California, Arkansas, Minnesota, Oregon, Missouri, Louisiana, Wisconsin, Marshes, Wetlands, \*Swamps, Land reclamation, Land ownership, Land classification, \*Federal-state water rights conflicts, Ownership of beds, \*Prior appropriation, Patents, Federal government, States, Levels, Drains, \*Legislation. Identifiers: \*Overflowed lands, Indemnity to states.

The statute deals generally with recognition by the Federal Government of the prior rights of the states in regard to the swamplands within their boundaries. Section 981 is concerned with a state's right of indemnity for prior purchases of swampland from the Federal Government. Section 982 enunciates a policy to aid the states in reclaiming swamplands. Section 983 deals with the duties of the Secretary of the Interior under this act. Section 984 sets up standards for inclusion into plats and lists of swamp and overflowed lands which the act covers. Section 985 deals with patents to prior purchasers. Section 986 deals with the mode of selection and confirmation of swamp and overflowed lands coming under the act. Sections 987-994 deal with the specific application of the bove sections to the states of California, Minnesota and Oregon, Missouri, Arkansas, Louisiana and Wisconsin, respectively. (Carruthers-Fla) W69-02458

RIGHTS OF FISHING, BOATING, BATHING, OR THE LIKE IN INLAND LAKES, C. C. Marvel.

57 ALR 2d 569-596.

Descriptors: Judicial decisions, Great ponds, \*Lakes, Lake beds, Ownership of beds, \*Riparian rights, Riparian land, \*Fishing, Boating, \*Public

rights.
Identifiers: Public Trust Doctrine.

Generally the public has rights in the use of the surface of public, or navigable waters while the owner of the soil beneath private or non-navigable waters has an exclusive right to the use of the surface thereof. This is also the rule for fishing rights. Cases involving public or navigable lakes, and public rights therein are set out. The conflict between public and riparian rights is discussed. Cases on the Great Lakes and great ponds of New England are discussed. Owners of beds of private lakes, especially those which are non-navigable in fact, have exclusive rights to the use of the waters. The remedies of trespass and injunction to protect these rights are discussed. Riparian owners, who do not own any of the lake bed are generally held not to have rights of fishing, boating and bathing. Cases involving conflicts between multiple owners of lake bottoms, where such ownership is not based on riparian rights, are discussed. Each is allowed to use the water above the portion of the bed he owns. However, the owners of portions of a lake bed by virtue of riparian rights all have common right to use the entire lake. Finally, cases involving prescriptive rights and dedication are examined. (Williams-Fla) W69-02460

AN ACT CONCERNING THE ELIMINATION OF POLLUTION OF THE WATERS OF THE STATE.

For primary bibliographic entry see Field 05G. For abstract, see . W69-02462

AN ACT CONCERNING THE ELIMINATION OF POLLUTION OF THE WATERS OF THE

For primary bibliographic entry see Field 05G. For abstract, see . W69-02463

SHOREHAVEN GOLF CLUB, INC V WATER RESOURCES COMMISSION (DENIAL OF DREDGING APPLICATION).

146 Conn 619, 153 A 2d 444-448 (1959).

Descriptors: \*Connecticut, \*Administrative decisions, Judicial decisions, Ownership of beds, Permits, State governments, Channels, \*Channel improvement, \*Dredging, Desilting, Beds, Navigable waters, Riparian waters, Riparian rights, Regulation. Administrative agencies.

Plaintiffs applied to defendant-commission for designation of a channel under trial waters and for permission to dredge and remove materials from it. The defendant denied the application. Plaintiffs brought suit to force defendants to act favorably on their application. The court held that when plaintiffs urged their plan as the only one feasible and the defendant denied it, defendant was not under any duty to make suggested changes or to grant a rehearing for that purpose. Since the proposed operation was in essence a commercial venture to remove and sell submerged sand and gravel presently in the proposed channel and to develop plaintiffs' shore properties at a very modest cost to them, the defendant properly denied the application as an unwarranted taking of state-owned underwater lands for private purposes. (Scott-Fla) W69-02464

DEPARTMENT OF WATER RESOURCES ACT. NC Gen Stat sec 143-351--143-355 (1967).

Descriptors: \*North Carolina, Legislation, State governments, \*Water resources, Natural resources, Water conservation, Water policy, Water pollution, \*Water resources development, Water utilization, Planning, Governments, Research and development, Water utilization.

The Department of Water Resources was created to coordinate the state's water resources activities; to devise plans and policies; and to perform the research and administrative functions necessary to insure improvement in the methods of conserving, developing and using those resources. The department shall be governed by the Board of Water Resources which will consist of seven members to be appointed by the governor. The board shall organize the department into a Division of Water Pollution Control, a Division of Navigable Waterways, and such other divisions or units as it deems necessary. The act creating the department and the sary. The act creating the department and the board lists the ordinary powers and duties of the board, which include conservation planning and education; advising the governor; recommending relevant legislation; and adopting such rules and regulations as may be necessary to carry out the purposes of the act. The board may also declare a water emergency, in which case it had additional powers and responsibilities. Powers, duties, functions, and responsibilities relating to water resources formerly vested in the Department of Conservation and Development are transferred to the Department of Water Resources. (Scott-Fla) W69-02467

WATER RESOURCES ADMINISTRATION IN DELAWARE,

Delaware Univ., Newark. Urban Affairs Div. Roger S. Hoeh.

Research Project Partial Technical Completion Report to Office of Water Resources Research, De-partment of the Interior, Washington, D. C., November 1, 1968, 4p. OWRR Project A-003-Del.

Descriptors: Legal framework, \*Administrative organization, \*Intergovernmental relations, Water resources policy, Water rights, Interagency coordination, \*Delaware River Basin Commission, Intrastate water programs, Interstate cooperation.

The legal framework within which water resources are administered inhibits and complicates the formulation of a comprehensive, statewide policy on water resources. It is especially deficient with regard to definition of water rights, their use and allo-cation. Future legal problems will be concerned: with (1) defining the scope of water rights, (2), providing a mechanism for implementing and enforcing a water resources plan and (3) coordinating policies of water-oriented state agencies. Deficiencies in the administrative framework also inhibit the formulation of a statewide policy on water resources. There is a lack of formal coordination between states agencies concerned with water resources. There should be a formal program coordinating body, or a merger of existing agencies under a department of natural resources with a director responsible for coordinating policy. The Delaware River Basin Commission is the focal point of intergovernmental relations in the area of water resources. Delaware's interest can be endangered by some of the aforementioned weaknesses of its legal and administrative framework. The lack of formal intrastate program coordination, the absence of a single water resource policy, and the absence of any formal advisory body to assist the state's delegate to the DRBC all combined to make coordination between DRBC and state programs difficult. Aforementioned administrative change, and an advisory body or its equivalent, could correct this situation. W69-02469

CONGRESSIONAL HANDLING OF WATER RESOURCES,

Library of Congress, Washington, D. C. Legislative Reference Service.

Theodore M. Schad, and Elizabeth Boswell. Water Resources Research, Vol 4, No 5, 849-863, Oct 1968. 15 p, 2 tab, 24 ref.

Descriptors: \*Legislation, \*Water Resources Research Act, Water pollution control, Water resources development. Identifiers: \*Congressional Organization, Corps of Engineers, Bureau of Reclamation, \*Federal pro-

ject policy, Appropriations committees.

In the 89th Congress, 1289 legislative measures, more than 5% of the total number introduced, were concerned with water resources. The United States Congress, patterned on experience in Great Britain, embodies the theory of separation of powers expressed in the United States Constitution. To handle the heavy legislative work load, proposed legislation is considered first in committee before debate on the floor. The committees thus have great power in shaping the nature of legislation. Under the present committee structure many factors other than water resources have been given predominance. As a result, under the rules of the Senate and House of Representatives governing referral of bills, water resources measures were referred to 11 committees in the Senate and 13 committees in the House of Representatives.

Although there are some instances where inconsistent policies have evolved in water resources programs because the legislation emanated from different committees, there are others where committees have cut across jurisdictional lines to propose legislation that provides uniform policies applicable to all Federal programs. (Seneca-Rutgers) W69-02532

SOME INSTITUTIONAL ASPECTS OF WATER RESOURCE DEVELOPMENT: A CASE STUDY

OF MONTANA, Montana State Univ., Bozeman. Chennat Gopalakrishnan.

Proceedings of the Third Annual American Water Resources Conference, 1967, pp 215-221, 7 p.

Descriptors: \*Montana, \*Institutional constraints, Political constraints, \*Water resource development, Legal aspects, Water law, Federal government, Legislation, Prior appropriation, Water rights, Conservation, State government, Administrative agencies, Political aspects, Dam construction

Identifiers: Conservancy districts.

This article discusses some of the institutional aspects related to Montana's water resource development. It indicates how these institutional impediments have slowed down considerably the optimum development of the state's water resources. The author concludes that the success of a program of water resource development depends upon a host of institutional factors as well as economic considerations. The search for efficiency in water utilization through water transfer can be successful only if these institutional aspects are recognized. In order to overcome most of the institutional blocks, in addition to removing the legal and administrative handicaps, concerted effort should be undertaken to educate people at the 'grass roots' level. The results of technical research have to be passed on to the general public in a form that is fully comprehensible to them. (Seneca-Rutgers) W69-02542

## WATER RIGHTS LITIGATION AND LEGISLA-TION, 1967, Taylor and Smith, San Bernardino, Calif.

Edward F. Taylor. J Amer Water Works Ass, Vol 60, No 9, pp 1001-1014, Sept 1968. 14 p, 51 ref.

Descriptors: \*Water rights, \*Water law, \*Legal aspects, \*Legislation, Water supply, Jurisdiction, Judicial decisions, Riparian rights, States (Geographical), Water allocation (Policy), Water pollu-tion, Groundwater, Water resources, tion, Groundwater, Water resources, Demineralization, Water districts, Bibliographies, \*Water shortage. Identifiers: \*Litigation, Colorado River Storage

Proj. Waste Water reclamation, Pollution control.

As the United States' population multiplies and increasingly migrates to the cities, water resources take on more vital significance. Already in many areas water is a previous commodity. Water acquisition, with the attendant problems of conservation, pollution, and reclamation, faces city leaders throughout the nation. Not only must the thirst of the population be quenched, but also the needs of industry. This report scans recent national, regional, and state developments in the area of water problems. Developments in water pollution control, waste water reclamation, and salt water conversion are discussed. Recent acts of water legislation by several states are named, and notable cases of water litigation are cited. Problems in water district financing, organization, and annexation are discussed. (USBR)
W69-02560

## A FEDERAL WATER RESOURCES COUNCIL A PEDERAL WATER RESOURCES COUNCIL APPROACH TO WATER AND RELATED LAND RESOURCES PLANNING, Water Resources Council, Washington, D. C. Reuben J. Johnson.

Proc Ser No 3, Symp Amer Water Resour Ass, San Francisco, Calif, pp 184-196, Nov 1967. 13 p, 4 fig,

Descriptors: \*Water resources, \*Land resources, Pescriptors: "Water resources, "Land resources, Water utilization, River basins, River basin commissions, Interstate compacts, Resource development, Water management (Applied), Federal government, Interstate commissions.

Identifiers: \*Water resources management, \*Water Resources Conseil.

Resources Council.

The Water Resources Planning Act of July 1965 provides for a coordinated approach to planning the nation's water and related land resources. This is accomplished through establishment of a Water Resources Council, consisting of those Federal agencies involved in water resource programs; regional and river basin commissions that provide for gional and river basin commissions that provide for states as members; and providing financial assistance to states, enabling increased state par-ticipation in planning. Specific assignments of the Council include: (1) establishing principles, stan-dards, and procedures for performing comprehen-sive water resources planning, (2) assessing the national water resources situation, (3) establishing river basin commissions, and (4) reviewing and coordinating all water resources planning on the local and national level. Accomplishments of the Council and commissions are discussed. (USBR) W69-02589

#### WATER-USE LAW IN ILLINOIS.

Illinois Univ., Urbana; and Economic Research Service, Washington, D. C. Fred Mann, Harold Ellis, and N. G. P. Krausz.

Agricultural Experiment Station Bull 703, 1964. 332 p. 3 fig.

Descriptors: \*Illinois, Natural streams, Percolating Descriptors: "Illinois, Natural streams, Percolating water, Subsurface waters, Springs, Surface waters, Drainage, Remedies, Irrigation, Water pollution, \*Administrative agencies, \*Interstate compacts, Water resources, Water law, Riparian land, \*Riparian rights, Riparian waters, Water rights, Watercourses (Legal).

As water resources become economically more important, the legal structure governing rights and responsibilities in utilizing and developing these resources becomes more complex. Additional legislation may be needed to conserve water and encourage its most effective use, and sound legislation can best come from an informed public. In order to promote better understanding of water use law in Illinois, the Illinois Agricultural Experiment Station and the Resource Development Economics Division, Economic Research Service, U S Department of Agriculture, undertook the study reported here. An increasing number of problems and potential conflicts concerning the use, disposition, control and development of water resources can be expected in the years ahead. The book deals with these and numerous related subjects, including applicable federal laws and inter-state and interna-tional considerations. Laws of other states are also discussed to indicate possible directions in areas where Illinois Court decisions are unclear. The book contains an appendix of forms, recent court cases, lists of public streams and lakes, sanitary districts, and state projects. (Kahle-Fla) W69-02624

# CHAPTERS 1-4: WATER-USE LAWS IN IL-LINOIS; SOURCE OF THE LAW; STATE WATER-USE POLICY; TYPES OF WATER

WATER-USE POLICY, 11123 C. SOURCES, Illinois Univ., Urbana; and Economic Research Service, Washington, D. C. Fred Mann, Harold Ellis, and N. G. P. Krausz. In Water-Use Law in Illinois, pp 1-8, 1964. 8 p. (for main entry see W69-02624).

Descriptors: \*Water consumption, \*Illinois, Agriculture, Municipal waters, Industrial water, Sewage treatment, Hydrologic cycle, Legal aspects, Irrigation, \*Economic prediction, \*Water law, Water rights, Surface runoff, Watercourses (Legal), Groundwater.

According to a 1959 Governor's Report, the mean daily surface and groundwater supply available to Illinois is 43 billion gallons per day. Although this is 5 times the amount of present usage, the problem is that it is not uniformly available in place, time, or for municipal uses, with a substantial increase in industrial and recreational uses. There has been no rapid spread of irrigation use, but this area remains one of the greatest uncertainities for the state. 5 per cent of the population presently is not served with treatment plants, with three-fourths of these being along interstate water. The sources of Illinois water law are some rather disconnected legislation dealing with one phase or another of water use superimposed upon the common law of the state. There are few reported court decisions and thus the overall effect of applicable laws is often difficult to determine. The Illinois Courts have given little recognition to the hydrologic cycle. They have consistently classified sources as natural watercourses, percolating groundwater, or surface water, with different rules for different sources. (Kahle-Fla) W69-02625

#### CHAPTER 5: NATURAL WATERCOURSES.

Illinois Univ., Urbana; and Economic Research Service, Washington, D. C.

Fred Mann, Harold Ellis, and N. G. P. Krausz. In Water-Use Law in Illinois, pp 9-130, 1964. 122 p, 1 fig. (for main entry see W69-02624).

Descriptors: Natural streams, \*Riparian rights, Developed waters, Flooding, Artificial flow, Public benefits, Navigable waters, Lakes, Beds, \*Federal jurisdiction, \*State jurisdiction, \*Illinois, Water law, Riparian waters.

Natural watercourses are defined according to Illinois Law, which distinguishes them from other related types of water, eg, overflow waters. Illinois, in the 1842 case of Evans v Merriweather, adopted the doctrine of riparian rights, with some restric-tions of reasonableness. Natural uses are distinguished from artificial uses, with all natural uses being reasonable per se. Alterations in the quantity and quality of flow, as well as pollution, have been held to be unreasonable uses. As a general rule, a grant of riparian land conveys to the center thread of the stream. Bed ownership gives exclusive right to hunt and fish over the bed, even though the stream may be open to public navigation. The public has an easement of navigation in all waters navigable in fact. In some cases this is determined as of the date of Illinois' statehood. Upon statehood, Illinois acquired ownership of beds of all navigable waters, but none of the non-navigable waters, within its boundaries. For easement of navigation purposes, navigability is determined by federal criteria. However, Illinois has relinquished ownership of beds to riparian owners subject to the paramount powers of the federal government to improve interstate commerce. State jurisdiction over natural watercourses is outlined here, but discussed more fully in a later chapter. (Kahle-Fla)

## CHAPTERS 6-10: PERCOLATING GROUND-WATER'S SUBTERRANEAN WATERCOURSES; SPRINGS; SURFACE WATER; DRAINAGE, Illinois Univ., Urbana; and Economic Research Service, Washington, D. C. Fred Mann, Harold Ellis, and N. G. P. Krausz.

In Water-Use Law in Illinois, pp 130-143, 1964. 14 p. (for main entry see W69-02624).

Descriptors: \*Percolating water, Subsurface waters, \*Springs, Natural flow doctrine, \*Illinois, Legal aspects, \*Drainage, Drainage practices, Water law, Overlying proprietor.

The law with regard to percolating groundwater seems to be that it is part of the land itself, and belongs absolutely to the overlying owner to make whatever use he sees fit. The court has indicated, however, that it would not permit a malicious interference by use. There are no direct decisions as to questions regarding subterranean watercourses and springs. Indications are that subterranean watercourses are subject to the same rules as surface watercourses with a presumption, however, that subsurface waters are percolating waters. Springs are probably subject to the same rules as the source from which they derive their flow. All water on the surface not in a natural watercourse is considered surface water. This includes the overflow of at least the smaller rivers, though there is some doubt as to the overflow of large rivers. Illinois drainage rules generally follow the civil-law rule of natural flow, modified somewhat by the 1955 Code, which provides for drainage district organization and operation. (Kahle-Fla) W69-02627

## CHAPTER 11: WATER-USE REGULATION AND RELATED FUNCTIONS OF STATE AND LOCAL BODIES,

Illinois Univ., Urbana; and Economic Research Service, Washington, D. C. Fred Mann, Harold Ellis, and N. G. P. Krausz.

In Water-Use Law in Illinois, pp 143-191, 1964. 49 p, 1 fig. (for main entry see W69-02624).

#### Group 6E—Water Law and Institutions

Descriptors: \*Illinois, \*Administrative agencies, Interagency cooperation, \*Regulation, Boating regulations, Drainage districts, Building codes, Municipal water, \*Legislation, Legal aspects, Conservation, Permits, Water law.

Organizations in Illinois involved in water use regulation and related functions fall into four categories: (1) state departments, boards, and commissions; (2) local governmental units; (3) special district organizations created under permissive legislation; and (4) special district organizations created by statute. In the first category, the Dept. of Public Works and Buildings, with a general supervisory and regulatory power over all public waters, is the most directly concerned with water use regulation. This and the other departments and boards are discussed in detail. The second category includes municipalities, counties, and townships. The jurisdiction and powers of each are discussed. The third category includes soil and conservation districts, public water districts, drainage districts etc. They have regulatory powers over the use of water. Districts with more extensive powers include river conservancy districts and water authorities. Under the final heading are found port districts and certain sanitary and park districts. They are distinguished from other organizations concerned with water use in that they are not uniform throughout the state, but are unique and usually limited to a particular area, generally because of some unusal feature involving the water resources of that area. (Kahle-Fla) W69-02628

#### **CHAPTER 12: REMEDIES,**

Illinois Univ., Urbana; and Economic Research Service, Washington, D. C. Fred Mann, Harold Ellis, and N. G. P. Krausz. Water-Use-Law in Illinois, pp 191-228, 1964. 38 p. (For main entry see W69-02624).

Descriptors: \*Illinois, \*Remedies, \*Water rights, Riparian rights, Legal aspects, Pollution, Administrative decisions, Abatement, Legislation, Adjudication procedure, Water law, Legal aspects.

Remedies for the invasion of legally protected water rights are discussed. Where natural watercourses are involved, one must be a riparian owner or claim under one to bring an action. Actions for damages include alteration of quantity or quality of flow. The latter may include pollution or change of temperature. A court of equity may grant an injunction if it is shown that damages are inadequate and the injured party will suffer irreparable harm unless relief is granted. Equity may grant an injunction without a prior adjudication at law if plaintiff's right is clear and the disturbance by the defendant is an irreparable injury at law. Courts have by statute the power to order the abatement of a public nuisance by the sheriff at the defendant's expense where a criminal conviction has been above. pense where a criminal conviction has been obtained. In addition to these remedies various administrative remedies are available. Action by the proper department, board, or agency often settles disputes without litigation. Illinois also has an ar-bitration statute authorizing persons to agree in writing to the submission of controversies to arbitration. (Kahle-Fla) W69-02629

#### **CHAPTERS 13-14: TRIAL COURT ACTIVITY:** FEDERAL MATTERS,

FEDERAL MATTERS, Illinois Univ., Urbana; and Economic Research Service, Washington, D. C. Fred Mann, Harold Ellis, and N. G. P. Krausz. Water-Use Law in Illinois, pp 228-257, 1964. 30 p, 1 fig. (For main entry see W69-02624).

Descriptors: \*Illinois, Adjudication procedure, Consumptive use, \*Federal jurisdiction, Federal government, Water rights, Project purposes, \*Legal aspects, \*Administrative agencies.

Chapter 13 is a two page report on trial court activity in Illinois involving water-use conflicts

between 1956 and 1959. Questionnaires revealed few water-use cases. Of nine decided cases in 1956, six involved pollution, and none involved consumptive use conflicts. Only one case of significance involving consumptive use had arisen when the second set of questionnaires was sent out in 1959. Chapter 14 discusses federal regulations and programs that may have a bearing on Illinois water rights. The primary source of federal jurisdiction regarding water resources is the commerce clause the United States Constitution. Responsibilities and jurisdiction of the U S Army Corps of En-gineers, as well as the Federal Power Commission, the Coast Guard, the Dept of Health, Education and Welfare, the Dept of Agriculture, the Dept of the Interior, and the Dept of Commerce, are discussed in detail. (Kahle-Fla) W69-02630

#### CHAPTER 15: INTERSTATE AND INTERNA-TIONAL MATTERS,

Illinois Univ., Urbana; and Economic Research Service, Washington, D. C. Fred Mann, Harold Ellis, and N. G. P. Krausz.

In Water-Use Law in Illinois, pp 257-283, 1964. 27 p. (For main entry see W69-02624).

Descriptors: \*Illinois, International law, \*Equitable apportionment, \*Interstate compacts, International waters, Interstate rivers, State jurisdiction, Federal jurisdiction, Great Lakes, Ohio River, Lake Michigan, Pollution, \*Water law, Legal aspects. Identifiers: FWPCA.

Interstate and international matters involving water rights are discussed. The United States Supreme Court has exclusive and original jurisdiction in cases where states are parties. The Court may apply principles derived from international law, and has built an independent doctrine of interstate law known as the doctrine of equitable apportionment of benefits. Two or more states with interests in a body of water may control its use by interstate compact, subject to the consent of Congress. The Great Lakes Basin Compact and the Ohio River Valley Water Sanitation Compact are discussed. Special problems concerning Lake Michigan are also discussed. Illinois holds title to the bed of Lake Michigan within its boundaries in trust for the peo-ple of the state. The Federal Water Pollution Con-trol Act authorizes the federal government to abate pollution of interstate waters under supervision of the Secretary of Health, Education, and Welfare. The Supreme Court also has jurisdiction over interstate pollution cases, although interstate compact has been a more feasible method of dispute settlement. The significance of the Northwest Ordinance of 1787 as an element of federal law regarding federal jurisdiction and interstate matters is largely an open question under present court decisions. (Kahle-Fla)
W69-02631

#### RIVERS AND CREEKS - DRAWS IN BRIDGES ON NON-NAVIGABLE STREAM.

N C Gen Stat sec 77-10 (1967).

Descriptors: \*North Carolina, Legislation, \*Bridges, Boats, Rivers, Streams, \*Navigation, Administrative agencies, Navigable rivers, Navigable waters, \*Non-navigable waters, Roads, Highways. Identifiers: Draws.

Whenever the navigation of any river or creek which, in the strict construction of law, might not be considered a navigable stream, is obstructed by any bridge across the stream, except those under the supervision and control of the State Highway Commission, it is lawful for any person owning any boat plying on the stream to make a draw in the bridge sufficient for the passage of his boat. The owner of the boat must construct and maintain the draw at his own expense, and must use the draw in such a manner as to delay travel over the bridge as little as possible. (Watson-Fla) W69-02632

#### OBSTRUCTING NAVIGABLE WATERS.

N C Gen Stat secs 76-40--43 (1964).

Descriptors: \*North Carolina, \*Legislation, Administrative agencies, Boats, Ships, Navigable waters, Navigable rivers, Rivers, Channels, \*Navigation, Bays, United States, \*Lighthouses, Lumbering, Tributaries, Anchors. Identifiers: \*Obstruction to navigation, Beacons.

If any person throws any substance likely to be injurious to navigation into any navigable waters of the State of North Carolina, or willfully pulls down any beacon, stake, or other mark erected by the commissioners of navigation, he is guilty of a misdemeanor and must pay \$200 to the commissioners in whose waters the offense was committed. If any pilot knowingly allows any such unlawful act to be done, and does not report it to the commis-sioners within ten days, he will likewise be guilty of a misdemeanor. Besides the usual punishment, upon conviction, a pilot will never be allowed to act as a pilot in the State. It is also unlawful to obstruct the waters of Currituck Sound, and all persons now obstructing the waters are required to remove the obstructions. All lumbermen are required to remove all obstructions placed by them in the waters of Albemarle Sound, as soon as practical, after their initial purposes are fulfilled. If the master of any vessel anchors on the range line of any range of lights established by the United States lighthouse board, he will be guilty of a misdemeanor punishable by a fine not to exceed \$50, unless the anchorage is unavoidable. (Watson-Fla) W69-02634

HAFERKAMP V CITY OF ROCK HILL (ACTION FOR DAMAGES FROM COLLECTION AND DISCHARGE OF SURFACE WATERS). For primary bibliographic entry see Field 04A. For abstract, see . W69-02636

ADAM HAT STORES V KANSAS CITY (AC-TION FOR DAMAGES FROM BROKEN WATER LINE).

316 S W 2d 594-601 (Mo 1958).

Descriptors: \*Missouri, Judicial decisions, \*Cities, Pipes, Damages, \*Overflow, \*Conduits, Legal aspects, Water law. Identifiers: Negligence, Res ipsa loquitur.

Plaintiff brought this action against the city for damages to the plaintiffs merchandise resulting from a break in the city's water main. The verdict was for the city, but the trial judge granted a new trial because of an error in refusing to permit the plaintiff's attorney to call as witnesses two of its employees who were at the scene of the broken main shortly after it was discovered. The city appealed the granting of the new trial and also argued that no submissible case of the city's negligence was made under the res ipsa loquitur doctrine (the thing speaks for itself). Both rulings of the trial court were affirmed by the Supreme Court of Missouri, thus giving the plaintiff a new trial. The doctrine of res ipsa loquitur applied to city waterworks because: (1) the water mains were installed and maintained under the exclusive control of the city; (2) evidence showed that the breaking of a water main is an occurence that does not ordinarily happen if those in charge use due care; (3) the cause of the break was unknown to the plaintiff; and (4) the city had superior knowledge or means of informa-tion to ascertain the cause. (Watson-Fla) W69-02637

#### PEOPLE V KRAEMER (ANCHORAGE OF VES-SELS).

177 NYS 2d 425-429 (Suffolk County Ct 1958).

#### Water Law and Institutions—Group 6E

Descriptors: \*New York, Admiralty, Boundaries (Property), Judicial decisions, Public rights, Beds, \*Navigable waters, Ownership of beds, Navigation, \*Harbors, Ships, Shores, \*Intertidal areas. Identifiers: Trespassing, Trespass, Criminal trespass.

Defendants were charged with violation of a village ordinance proscribing trespassing in that defendants anchored their vessels upon plaintiff's submerged property in a navigable harbor and that one of the defendants entered upon the foreshore. The court found that, considering the navigable condition of the waters of the harbor, the temporary anchorage of boats constituted no crime. Only the defendant who intruded upon the foreshore had criminally trespassed. (Scott-Fla) W69-02641

#### JURISDICTION OVER NAVIGABLE STREAMS.

Ala Code tit 12, sec 175 (1958).

Descriptors: \*Alabama, \*Legislation, Streams, Jurisdiction, \*State jurisdiction, Legal aspects, State governments, Boundaries (Property), Riparian rights, \*Navigable waters.

Jurisdiction over navigable streams not within any county's limits belongs to the county or counties whose jurisdiction extends to the margin thereof and officers of cither county may execute all process on such streams. (Geraghty-Fla) W69-02642

# CORPORATIONS - POWER, RIGHTS, DUTIES (CONDEMNATION POWER OF WATER WORKS AND OTHER PUBLIC UTILITIES). Ala Code tit 10, sec 75-80 (1958).

Descriptors: \*Alabama, \*Legislation, \*Condemnation, Easements, Legal aspects, Water supply, \*Water works, Riparian rights, Cities, Rivers, Streams, Springs, Ponding, Water storage, Reservoirs, Public utilities, Right-of-way, Pipes.

Alabama, by statute, permits companies formed for the purpose of constructing, operating or maintaining any internal improvement or public utility to acquire right-of-way land by condemnation. Additionally, waterworks companies may condemn the water of any river, stream, spring or other water source to obtain a supply of water for their storage ponds, reservoirs, pipes and canals. In order to protect and preserve the purity of such supply, these companies may also acquire, through condemna-tion, riparian rights and all necessary adjacent lands to such watercourses. These ad quod damnum proceedings are to be instituted against the riparian land owner in the probate court of the county in which such lands are situated, in accordance with general state law providing for the condemnation of land for public purposes. However, no water company shall condemn a water source which is the property of another water company supplying a city or town with water. (Geraghty-Fla.) W69-02643

## SOVEREIGNTY AND OWNERSHIP OF WATERS WITHIN STATE BOUNDARIES. La Rev Stat secs 49:2-6 (1965).

Descriptors: \*Louisiana, Legislation, United States, \*Ownership of beds, Gulf of Mexico, \*Boundaries, Mississippi, State jurisdiction, Local governments, Ownership of beds. Identifiers: Sovereignty, State ownership of waters.

Subject to the rights of the United States, the state of Louisiana has full sovereignty over the beds, shores, and all waters of the Gulf of Mexico within the boundaries of Louisiana. These waters, beds and shores are owned by the state of Louisiana. The water boundary between Louisiana and Mississippi from the mouth of the Pearl River to the Gulf

of Mexico is fixed by decree of the Supreme Court of the United States and is marked and buoyed so as to be reasonably permanent and apparent. The gulfward boundaries of all coastal parishes are described. (Childs-Fla) W69-02644

#### MINERALS, OIL, AND GAS.

La R S 1965 30:124 172

Descriptors: \*Louisiana, \*Leases, State governments, Navigable waters, Navigable rivers, Breakwaters, Landfills, \*Mineral industry, \*Legislation, Public lands, Landfill, Permits, Beds. Identifiers: Mineral rights, Mineral leases.

The state mineral board may grant mineral leases on any state lands, including water bottoms. Any such lessee is permitted to build and control breakwaters, platforms, fills, islands, and any other facilities necessary or convenient for the production or marketing of minerals produced under such lease. A permit must be obtained before an island or fill is made within navigable waters. (Scott-Fla) W69-02646

## SERVITUDES; RIGHT OF PASSAGE AND OF WAY.

La Civil Code Arts 707, 711, 714, 720, 721, 723.

Descriptors: \*Louisiana, Right-of-way, Rural sociology, State governments, Well permits, \*Roads, Drains, Drainage, Pipes, Canals, Wells, Springs, \*Public rights, \*Legislation.

Identifiers: Servitudes.

Any landowner who is obligated to provide a public road along a river or stream must furnish another without compensation if the first becomes impassable or is washed away. Principal types of urban servitudes are listed. The right of drain consists in the servitude of passing water collected in pipes or canals through the land of one's neighbor. The right of drawing water, usually confined to those living in the house of the person enjoying the servitude, is a servitude by which one permits his neighbor to draw water from a well or spring he has on his property. Principal types of rural servitudes are listed. (Scott-Fla)

#### LIMITATIONS: PUBLIC DEBT, LANDS, ETC.

La Const Art 4, Para 2.

Descriptors: \*Louisiana, \*Leases, \*Ownership of beds, Riparian waters, State governments, Navigable waters, Navigable rivers, Land reclamation, Reclamation, \*Royalties, Mineral industry, Highways, Bridges, Roads.
Identifiers: Mineral rights, Mineral leases.

The state legislature may not alienate, or authorize the alienation of, the ownership of any bed of a navigable stream, lake, or other body of water except for the purpose of reclamation. The mineral rights on such beds sold by the state shall be reserved, except where the property is redeemed by one who has lost the property for non-payment of taxes. The legislature is not, however, prohibited from leasing such lands for mineral or other purposes. From all mineral leases granted by the state or state-owned land, lake and river beds and other state-owned water bottoms, ten per cent of royalties received from such leases shall be placed in a special fund for the credit of the parish from which the production is had, to be used exclusively for building and maintaining roads, highways, bridges, tunnels and ferries in said parish. (Scott-Fla) W69-02648

SHAFFER V BAYLOR'S LAKE ASSOCIATION (PRESCRIPTIVE RIGHTS TO USE OF A LAKE).

392 Pa 493, 141 A 2d 583-587 (1958).

Descriptors: \*Pennsylvania, Easements, Judicial decisions, Riparian rights, \*Prescriptive rights, \*Non-navigable\_waters, Lakes, \*Ownership of beds, Boating, Fishing.

Plaintiff owned an individed majority interest in a piece of land abutting on a non-navigable lake. For fifty years the family of plaintiff had used the lake for swimming, boating, fishing, etc. Plaintiff's family had held title to the lake bottom. When defendant purchased the lake, plaintiff's right to the use of the lake was challenged. Plaintiff brought suit to quiet title to use of the lake, claiming rights to fishing, boating, swimming and commercial or rental boating. The jury found for the plaintiff, but judgment notwithstanding the verdict was entered for defendant. Plaintiff appealed to the Supreme Court of Pennsylvania which reversed. The court held that plaintiff had established prescriptive rights to swim, boat, fish, maintain her present dock, and water her cattle, but not to commercial boating or any commercial use of the lake. The court stated that riparian rights do not attach to lands abutting on non-navigable lakes, where the lake bottom is owned by others. Invasion of the water under such circumstances is trespass. However, plaintiff had showed open and continuous use of the lake for the non-commercial purposes enumerated, and the court held that it had gained these rights by prescription. (Williams-Fla) W69-02649

## GRAND RIVER DAM AUTHORITY V UNITED STATES (COMPENSATION FOR STATE WATER RIGHTS).

153 F Supp 153-159 (1959).

Descriptors: \*Oklahoma, \*United States, Judicial decisions, \*Federal-state water rights conflicts, Administrative decisions, Navigable waters, Nonnavigable waters, Dams, Reservoirs, Eminent domain, Legal aspects, Compensation, Tributaries, Flood control, Beds, Hydroelectric power, Hydroelectric plants, Highwater mark, Water courses (Legal).

Identifiers: Arid states doctrine, Flood Control Act, Fast lands.

An agency of the state of Oklahoma was empowered to build 3 dams. One was completed and land, easements, and rights-of-way for the others had been obtained. Congress then passed the Flood Control Act and authorized construction of dams on these same sites. One of these dams was completed by the federal government. The state agency sued the United States for the taking of its property, seeking compensation for its water power rights, its exclusive franchise to develop electric power, and certain items of severance damage. The state right to control non-navigable waters is subordinate to the right of the United States to control such waters for purposes of control of navigable waters. But, if, in the exercise of this right, private property on a non-navigable stream is taken, the United States must pay just compensation. The items of severance damages were not property rights and were not compensable. (Childs-Fla) W69-02652

## VARTELAS V WATER RESOURCES COMMISSION (ESTABLISHMENT OF ENCROACHMENT LINE).

146 Conn 650, 153 A 2d 822-826 (1959).

Descriptors: \*Connecticut, Administrative decisions, Eminent domain, Judicial decisions, Legislation, \*Permits, Public benefits, State governments, Water resources development, \*Regulation, Zoning, Water zoning, Building codes, Control, Banks, \*Flood control, Flood protection, Flood damage, Floods, Rivers.

Identifiers: Naugatuck River.

### Field 06 - WATER RESOURCES PLANNING

### Group 6E-Water Law and Institutions

A water resources commission established, along the bank of a river, a line beyond which, in the direction of the river, no structure or encroachment could be placed without its permission.
Plaintiff's land was affected by the commission's action, and he appealed, claiming that the establishment of the line constituted an unconstitutional taking of the property for a public use without compensation. The purpose of the act under which the commission acted was to enable the commission to forestall, by stream clearance, channel improvement, and other flood control measures, the recurrence of recent serious flood damage. This was held to be a valid exercise of the police power of the state. The police power regulates use of property because uncontrolled use would be harmful to the public interest. Eminent domain, on the other hand, takes private property because it is useful to the public. The court held that the commission did not abuse its powers in proceeding by way of regulation rather than by way of eminent domain. The commission's refusal to permit plaintiff to erect a building within the encroachment line was, under the circumstances, justified. (Scott-Fla) W69-02653

#### BEVELANDER V TOWN OF ISLIP (POWER TO LEASE BAY FLOOR FOR SHELLFISHING).

185 NYS 2d 508-511 (1959).

Descriptors: \*New York, Judicial decisions, Legislation, Bays, \*Shellfish, \*Commercial fishing, Navigable waters, \*Ownership of beds, Land tenure, Public rights, Legal aspects.

A taxpayer sought to annul a lease by the town granting lessee use of bottom of a certain bay for planting and cultivating shellfish. The title to lands under water passed to the states after the revolution. The only limitation on grants of these lands by the legislature was that they not be in derogation of rights. The right to plant, grow, and own shellfish in navigable waters was never considered to be an appropriation in derogation of public rights. Hence there is no inherent disability in the state of New York to convey the bay floor to a town. Such a conveyance rests in the town the right to lease the bay floor for shellfishing purposes. (Childs-Fla) W69-02655

#### LAKESIDE PARK CO V FORSMARK (NON-NAVIGABLE PONDS). 396 Pa 389, 153 A 2d 486-490 (1959).

Descriptors: \*Pennsylvania, Judicial decisions, Ownership of beds, Public rights, Relative rights, \*Navigable waters, Bodies of water, Surface waters, Navigation, \*Non-navigable waters, Ponds, \*Lakes, Standing waters, Great ponds, Reasonable use, Recreation, Legal aspects. Identifiers: Sandy Lake.

Defendant wanted to make commercial use of his Defendant wanted to make commercial use of his lakeshore property, which he was allowed to do if the lake was navigable and public, but which he could not do if it was non-navigable and private. Plaintiff sued to enjoin such use, asserting that the lake was non-navigable. The lake, 5,070 feet long and 1,930 feet wide at its widest point, formerly had been used see a count area and was serviced by had been used as a resort area and was serviced by nad been used as a resort area and was serviced by a railroad which made trips around the lake. Plaintiff, who owned most of the bed, operated summer cottages on its own property. Defendant's whole case for navigability rested on the past uses of the lake. The court stated that the concept of navigability should depend upon whether the water was used or usable as a broad highroad for commerce and the transport, in quantity, of goods and people. and the transport, in quantity, of goods and people, (the rule naturally applicable to rivers and to large lakes) or whether the water remained a local focus of attraction. (The rule applicable to shallow streams and small lakes and ponds). The basic dif-ference is that between a trade route and a point of interest; the first is a public use, while the second private. The court found that the lake in question

was a small lake or pond and not navigable. (Scott-W69-02656

#### BRADLEY V COUNTY OF JACKSON (RIPARI-AN RIGHTS IN ARTIFICIAL LAKE).

347 S W 2d 683-691 (Mo 1961).

Descriptors: \*Missouri, Judicial decisions, \*Rightof-way, Easements, Riparian land, \*Riparian rights, Recreation, Lakes, Developed waters, Public rights, Water law, Artificial watercourses, Fishing, Domestic water, Boating, Swimming. Identifiers: \*Artificial lakes.

This action was brought by several landowners surrounding an artifically created lake, against the county for a declaration that the plaintiffs possess riparian rights in the lake. The trial decisions was for the plaintiffs and the county appealed. The Supreme Court of Missouri reversed the decision and remanded the case to the lower court with directions as to ascertaining the rights of all parties. When the original owners granted land to the county to create the lake, reserving to themselves and their grantees the right to use the lake for appropriate purposes, those who took, directly or indirectly, from those grantors, land on the shoreline of the lake, acquired the riparian privileges of the original owners. These rights could be conveyed either by express grant, if stated in the deeds, or by implication. Riparian rights come from ownership of land abutting the water, and arise as incidents of ownership of upland soil, regardless of ownership of submerged land. Riparian rights of appropriate purpose include swimming, boating, fishing and taking water for domestic purposes. (Blunt-Fla) W69-02658

#### NUGENT V VALLONE (PIERS).

161 A 2d 802-806 (1960).

Descriptors: \*Rhode Island, \*Legislation, \*Piers, \*Riparian rights, Riparian land, Water law, Navigable waters, Ownership of beds, Beds under water, Legal aspects, Boundaries (Property), Coastal structures, Public benefits, Bays, Navigation, Fishing, Public lands, Judicial decisions. Identifiers: \*Narragansett Bay.

This action concerns the possible violation of public rights in the public waters of the state by the construction of a proposed pier. It was contended that the pier would be an interference with navigation and would constitute an unlawful appropriation of the public domain under the waters. The court held that the evidence indicated that respondent corporation was the owner of the entire east shore directly opposite the proposed pier and, as the sole riparian owner thereof, had the right to wharf out into the east passage in order to obtain the full advantages of navigation. It is true that the state holds title to the soil under the public water of the state. However, the state holds such title merely as trustee for the public in order to preserve its rights of fishery, navigation and commerce in such waters. The duly constituted public authorities had certified that the proposed pier would not interfere with any of those public rights. The court denied the appeal and affirmed the decision of the lower court. (Smith-Fla) W69-02660

#### UNITED STATES V REPUBLIC STEEL CORP (RIVERS AND HARBORS ACT).

362 US 482-488 (1960).

Descriptors: \*Judicial decisions, \*Rivers and Harbors Act, Federal government, Obstruction to flow, \*Industrial wastes, \*Navigable waters, Beds, Legislation, Administrative agencies, Navigation, Rivers, Depth.

The United States, petitioner, brought suit against respondents to enjoin them from depositing industrial solids into the Calumet River and to direct them to restore the depth of the channel. The US alleged that respondents' activities violated sec 10 of the Rivers and Harbors Act by creating an obstruction to the navigable capacity of a river which did not come within the exception for refuse flowing from streets and sewers in a liquid state. The evidence showed respondents' took water from the river for use in their operations and returned it containing solids in suspension that eventually settled to the river bottom. The depth of the river was significantly reduced around respondents' industrial sites. The District Court found for petitioner and the Court of Appeals reversed. On certiorari, the Supreme Court held that respondents' activities constituted an obstruction as contemplated by the Act, the exception provided in the Act extending only to sewage. The Court granted the injunctive relief asked. Four justices dissented at length on the grounds that respondents' activities were not proscribed by the Act. (Williams-Fla) W69-02662

AN ACT AUTHORIZING THE STATE OF MIS-SOURI TO MAKE GRANTS... TO PAY... THE COSTS OF WATER POLLUTION CONTROL PROJECTS WHICH QUALIFY... UNDER THE FEDERAL WATER POLLUTION CONTROL ACT.

Missouri Laws ch S 396 (1967).

Descriptors: \*Missouri, \*Legislation, Public utility districts, \*Sewage districts, \*Government supports, Sewers, Sewage treatment, Government finance, Government finance (Taxes), Planning, \*Cost sharing, Cost allocation, Water pollution control, Sewage disposal, Operation and maintenance. Identifiers: FWPCA.

The state is authorized to make grants to its political subdivisions qualifying for Federal aid for purposes of constructing water pollution control projects. The act provides for federal-state cooperation and makes funds available to such projects on the basis of relative need and priority. The aim of the act is to encourage the construction and maintenance of common sewer systems and treatment plants. The citizens of the proposed project areas must approve, by referendum, any application for consolidated sewage districts. Sewage districts, when approved, may be either single or multi-county. The districts shall be considered a distinct, corporate and political body, and it shall possess all the rights and liabilities accruing to such entities. District boards shall have the power to determine where and what types of wastes may lawfully be discharged into the facilities of the district. Drainage districts may be supported via issuance of revenue bonds by constituent municipalities. If, after the sewer system is constructed, the voters defeat proposals for the issuance of bonds, the system may be financed via levying of special real property taxes. Under the act, each district board may apply for and accept state and/or federal funds and grants to defray the local construction costs of sewer systems. (Blunt-Fla) W69-02663

## WATERCOURSE MADE LAWFUL FENCE BY COUNTY COMMISSIONERS.

N C Gen Stat sec 68-3 (1964).

Descriptors: North Carolina, Legislation, Legal aspects, Local governments, Watercourses. Identifiers: Fences.

This section provides the procedures whereby any watercourse may be made a lawful fence. (Childs-W69-02701

### Water Law and Institutions — Group 6E

#### PROTECTION OF SAND DUNES ALONG **OUTER BANKS.**

N C Gen Stat sec 104B-3--13 (1967 Supp).

Descriptors: \*North Carolina, Legislation, Administrative agencies, Regulation, Local governments, Hurricanes, Storms, \*Dunes, Atlantic Ocean, Southeast U S, Banks, \*Barriers, \*Erosion, Public health, Beaches, Legal aspects, Beach erosion, State governments, Permits.
Identifiers: Shoreline Protection Officer.

The legislature has deemed it necessary to protect the system of protective dunes along the Atlantic Ocean. This act makes it unlawful to damage or remove any sand dune lying along the outer banks or to destroy or remove any vegetation growing on said dunes without first having obtained a permit. Any county may establish a shore protection line whereby the provisions of this subsection will only apply to the ocean side of said protection line. No permit will be issued unless it is found that the dune will not be materially weakened or reduced in effectiveness. The act provides the method for appointment of a Shoreline Protection Officer. The duties of the Shoreline Protection Officer are provided. The Board of County Commissioners is empowered to adopt regulations necessary to enforce this act. The Commissioners are also authorized to levy a tax to pay the expenses in carrying out this act. Provision is made for the appeal and review of any decision by a Shoreline Protection Officer. The Department of Water Resources shall establish a project protection line along which beach restoration or hurricane protection projects will be constructed. No construction on the ocean side of the project protection line is allowed. Provision is made for punishing violations of any part of this act. (Childs-Florida) W69-02702

#### INLAND WATERWAYS.

N C Gen Stat 104-12--25 (1964).

Descriptors: \*North Carolina, \*United States, Legislation, Administrative agencies, Regulation, \*Inland waterways, \*Right-of-way, Real property, Marshes, Beds, Condemnation, Eminent domain,

Damages.
Identifiers: Cape Fear River, Beaufort Inlet.

To aid in the construction of the Inland Waterway by the United States from the Cape Fear River to the North Carolina-South Carolina state line, the Secretary of State is authorized to grant the land within the Inland Waterway right of way. If title to any land within the right of way is not in the state, then the state is authorized to condemn the land with the special benefits to the owner being offset against the damage to such lands. The state shall have the right to immediate possession of any such lands condemned. If determined to be necessary, the United States shall have the right to condemn land. North Carolina shall have concurrent jurisdiction over all lands held pursuant to this act. The act also provides for similar grants by the state and condemnation proceedings of land within the waterway right of way from Beaufort Inlet to the Cape Fear River. (Childs-Florida) W69-02708

#### ACQUISITION OF LANDS FOR RIVER AND HARBOR IMPROVEMENT.

N C Gen Stat sec 104-6 (1964).

Descriptors: \*North Carolina, United States, Legislation, Legal aspects, Rivers, Harbors, Navigation, \*Condemnation, Locks, Dams, Navigation, \*Condemnation, Locks, Dams, \*Federal jurisdiction, \*State jurisdiction, Eminent

The legislature has authorized the United States to acquire land by purchase or condemnation for use as sites for locks and dams or for any other purpose

connected with the improvement of rivers and harbors within the State. The State retains concurrent jurisdiction with the United States over lands acquired pursuant to this act. (Childs-Florida) W69-02709

#### RECREATIONAL USE OF STATE LAKES REGULATED - FORFEITURE FOR FAILURE TO REGISTER DEEDS.

N C Gen Stat secs 146-18, 146-20 (1964).

Descriptors: \*North Carolina, \*Legislation, Lakes, \*Recreation, Hunting, Fishing, Grants, Administrative agencies, \*Swamps, Regulation, Surveys, Legal

Identifiers: Deeds, Escheat.

All recreation, except hunting and fishing, in, upon, or above all the lakes in North Carolina may be regulated in the public interest by the state agency having authority over these areas. All the grants and deeds of swamp lands made prior to November 1, 1883, must have been proved and registered in the county where the lands are situated within 12 months from November 1, 1883. Every such grant or deed not registered in that time is void, and the title of the proprietor in such lands shall be deemed to have reverted to the state. The above provisions are applicable only to the swamp lands which have been surveyed or taken possession of by, or are vested in, the state or its agencies. (Watson-W69-02711

## WISCONSIN POWER AND LIGHT CO V PUBLIC SERVICE COMMISSION (VALIDITY OF ORDER TO OWNER OF DAM).

5 Wis 2d 167, 92 N W 2d 241-247 (1958).

Descriptors: \*Wisconsin, Judicial decisions, \*Dams, Rivers Administrative agencies, State jurisdiction, \*Regulation, \*Flow rates, Riparian rights, Legislation, Flow measurement, Hydroelectric plants, Water law.

Identifiers: Police power, Minimum flow.

The Wisconsin Public Service Commission issued an order to the Wisconsin Power and Light Co to maintain one of its dams in such a way as to provide a specified minimum flow in the river. The order was given after petition by riparian owners and others to the Public Service Commission, and a public hearing. The power company contended that the commission did not have the authority to issue such an order. On appeal to the Wisconsin supreme court, the order was upheld. The court pointed out a provision in the act allowing the power company's predecessor to build the dam, which reserved the right to amend the act. This refuted the company's contention that to limit its use of the dam impaired an obligation of contract. The court further stated that it was within the state's police power to protect public rights in navigable waters, by regulation of the company's operation of the dam. The federal government had not issued any regulations applying to this river. The court also held that the taxpayers and riparian owners had standing to petition the commission for this order. (Williams-Florida) W69-02712

### VMJ COMPANY V CITY OF LORAIN (EXTENT OF MUNICIPAL SEWAGE AND WATER SER-VICE).

151 N E 2d 667-672 (Ohio Ct App 1957).

Descriptors: \*Ohio, Judicial decisions, \*Cities, \*Utilities, Sewage disposal, Sewers, Water supply, Plumbing, Water delivery, Legal aspects. Identifiers: City limits.

Plaintiff brought suit for declaratory judgment contending that it was a bona fide inhabitant of the city of Lorain and that the city would have to provide the shopping center which it owned with water and sewage tap-ins. The shopping center was partially within and partially without the city limits. The city was authorized by the Ohio Constitution to enact legislation extending utility service beyond the city limits, but as yet, it had not done so. The company maintained that since part of its building was within the limits, service should be provided for the entire building. On appeal, it was held that the Company would have been entitled to service if it had wholly occupied the building. However, much of the part of the building outside the city limits was to be rented or leased to other parties. Therefore, the company could not compel the city to provide service for the entire building because those renting the part of the shopping center outside the city limits were not inhabitants of the city. (Williams-Fla) W69-02713

#### THURLOW V TOWN OF PROVINCETOWN (MAINTENANCE OF CITY WATER SYSTEM).

149 NE 2d 901-905 (Mass 1958).

Descriptors: \*Massachusetts, Judicial decisions. \*Cities, Water supply, \*Water works, Local governments, \*Metal pipes, Conduits, Freezing, Damages, Municipal water.

Plaintiff brought suit against the city to recover for damage to his house caused by fire. Plaintiff alleged that the fire was caused by the city's negligence in allowing electricity to escape into his house while a welding machine was being used to thaw out the defendant's underground water system. On appeal, the Supreme Judicial Court of Massachusetts held that although a city is liable for its negligence in the operation of a water system, the evidence in this case was not sufficient to establish a master-servant relationship between the city and the independent welding contractor who did the work in this case, thereby imputing his negligence to the city. (Wil-W69-02714

### STATE V MARTIN (CONSTITUTIONALITY OF STATUTE REQUIRING WELL DRILLERS TO SUBMIT LOGS).

152 N E 2d 898-905 (Ohio Ct App 1957).

Descriptors: \*Ohio, Judicial decisions, \*Legislation, \*Wells, Drilling, Groundwater, Well regulations, Administrative agencies, Regulation, \*Logging (Recording), Legal aspects, Conserva-tion, Natural resources.

Identifiers: Police po Constitutional objec-

Defendant was charged with violation of a statute requiring persons who drilled wells for hire to file logs with the Division of Water of the Department of Natural Resources. Defendant claimed that the statute was unconstitutional on two grounds: (1) that it denied him equal protection of the laws in that it applied only to those who drilled wells for hire, and (2) that, by requiring him to provide valuable information, it deprived him of property without due process of law. The state appealed from two adverse rulings. The Ohio Court of Appeals reversed, holding that statute constitutional. The court said that the police power of the state encompasses the power to legislate for the protection of natural resources. A statute establishing as a class those who drill wells for hire is not unreasonable and arbitrary because it applies only to that class and does not violate the state constitutional requirement that laws be uniform of application. The Constitution of Ohio specifically grants to the legislature the power to pass laws for the protection of natural resources. The court further held the statute did not deprive defendant of property without due process of law. (Williams-Fla) W69-02716

### Group 6E—Water Law and Institutions

WOODSIDE HOMES, INC V TOWN OF MOR-RISTOWN (COSTS OF EXTENSION OF WATER MAINS).

26 N J 529, 141 A 2d 8-17 (1958).

Descriptors: \*New Jersey, Judicial decisions, Administrative agencies, \*Administrative decisions, Cities, Conduits, \*Pipelines, \*Costs, Financing. Identifiers: Primary jurisdiction doctrine, Prior resort doctrine, Estoppel.

Appellant construction company brought suit against respondent city based on an agreement entered into by the parties, whereby the city extended its water mains to supply appellant's real estate development. The cost of such extension was borne by appellant. Its complaint contained two counts: the first sounded in tort and alleged a violation of the city's public duty to extend its mains at its own expense; the second was an action in quasi contract based on unjust enrichment in that the city obtained valuable property at appellant's expense. At trial the court held that the agreements were voluntary and binding and dismissed the complaint. On appeal, the Supreme Court affirmed. The court stated that in order for the developer to recover his expenses for extension of the mains, he must show either a violation of an absolute statutory duty or an abuse of discretion by the city. The court also stated that the decision as to whether an extension of mains will be ordered lies with the Board of Public Utility Commissioners in the first instance. This was the doctrine of 'primary jurisdiction' or 'prior resort,' and such doctrine precluded a judicial determination until the agency had ruled. How-ever, the court did not remand the case to the Board because it held that by its actions in contracting with respondent, the appellant was estopped to deny the efficacy of the agreements. (Williams-Fla) W69-02718

## OBSTRUCTING NAVIGATION AND DAMS STATUTE.

Ala Code tit 38, secs 104-122 (1958).

Descriptors: \*Alabama, Control, Navigation, Stream improvement, Easements, Eminent domain, Legal aspects, Water law, Permits, Prescriptive rights, Riparian rights, \*Navigable waters, Navigable rivers, Obstruction to flow, Barriers, Docks, \*Dams, Dam construction, State jurisdiction, Federal jurisdiction, Docks.

A definition of navigable streams is set out. Fines for obstructing streams used for floating timber, and for obstructing all other navigable water-courses are provided. Other specific acts relating to obstructing navigable streams are listed and expressly prohibited with fines for violation being provided. Firms organized for the purpose of improving navigation on a navigable river are given specific rights to construct dams and to obtain easements provided that plans are approved as prescribed. The prov isons of the statute relating to improvement of navigation are made retroactive. Rights of riparian owners to build wharves, docks and the like are maintained so long as state and national standards are complied with. It is provided that any tolls charged for the use of these wharves are subject to control by the state. (Pfeiffer-Fla)

## TOMBIGBEE-TENNESSEE WATERWAY DEVELOPMENT COMPACT. Ala Code (1t 38, secs 123-126 (1958).

Descriptors: Federal jurisdiction, \*Interstate compacts, \*Alabama, Mississippi, Interstate, State jurisdiction, Administrative agencies, \*Tennessee River, State governments, Inter-basin transfers, \*Interstate commissions, Rivers, Legal aspects, Water resources development, Water law, Interstate rivers, Expenditures, Financing.

The Governor of Alabama is herein authorized to execute a compact with the State of Mississippi in substantially the form set out. The expressed purpose of the compact is to promote the development of a navigable waterway connecting the Tennessee and Tombigbee Rivers. The Tennessee-Tombigbee Waterway Development Authority is provided for, and the authority's organization, duties and powers are prescribed. An appropriation is made to effectuate the statute's provisions. Procedure for admitting other states to the compact is set out. The governor of each member state and five other appointive member from each state compose the membership of the authority. The authority is empowered to acquire land to effectuate its functions, and to promulgate its own rules. The compact is to become effective when ratified by the member states and approved by Congress. (Pfeiffer-Fla)

### CHANGE IN OWNERSHIP OF LAND OR WATER BOTTOMS. La R S 9:1151 (1965).

Descriptors: \*Louisiana, Legislation, Land tenure, Stream beds, Navigable waters, \*Ownership of beds, \*Royalties, \*Leases, Legal aspects, Accretion

Identifiers: \*Mineral rights.

Where a change in the ownership of land or water bottoms occurs as a result of the action of a navigable body of water or as a result of accretion, dereliction, or other condition, the new owner shall take the same subject to, and encumbered with, any oil, gas, or mineral lease affecting such lands and subject to the mineral and royalty rights of the lessors in such lease. (Childs-Fla)

## BATTURE IN CITIES AND TOWNS - RIGHTS OF RIPARIAN OWNER.

La R S 9:1102 (1965).

Descriptors: \*Louisiana, Legislation, Local governments, \*Riparian rights, \*Accretion, Beds, \*Ownership of beds, Legal aspects.

When the riparian owner in any incorporated town or city is entitled to the right of accretion, and more batture has been formed than is necessary for public use, he shall have the right to institute an action for the batture not needed for the public use. (Childs-Fla) W69-02728

#### OWNERSHIP OF WATERS AND BEDS. La R S 9:1101 (1965).

Descriptors: \*Louisiana, Legislation, \*Ownership of beds, \*Navigable waters, \*Water bodies, Bayous, Rivers, Streams, Lagoons, Lakes, Bays, Beds, Domestic waters, Cities.

The waters and beds of all bayous, rivers, streams, lakes, and bays not under the direct ownership of any person on August 12, 1910, are declared to be property of the state. No charge shall be assessed against any person for the use of these waters for municipal, industrial, agricultural, or domestic purposes. All transfers to any levee district by the state of any navigable waters and the beds and bottoms thereof are void. (Childs-Fla) W69-02729

#### RIVER DEVELOPMENT CORP V LIBERTY CORPORATION (RIGHT TO IMPROVE SUB-MERGED TIDELANDS). 51 N J Super 447, 144 A 2d 180-199 (1958).

Descriptors: \*New Jersey, Judicial decisions, \*Tidal waters, Reclamation, \*Land reclamation, Dredging, Beds, Legislation, \*Permits, State governments, Navigable waters, Riparian rights,

Riparian waters, Grants, High water mark, Rivers, , Shores, Railroads, Docks. Identifiers: Tidelands.

Plaintiff's predecessors in title were granted permission by virtue of a special legislative act to improve lands under tidal waters. When defendant began certain dredging operations in the tidal waters of the river mentioned in the above act, plaintiff sued to enjoin the defendant from continuing the dredging, and for a declaration of rights of the plaintiff corporation in and to such subaqueous tidal lands. The court held that the special legislative act enabling the plaintiff to reclaim tide-flowed lands and erect wharves and other permanent improvements created a revocable license rather than a grant, and that the failure to exercise the rights granted under such licenses at the location in question for over eighty-six years constituted an abandonment of those rights. Also, plaintiff's predecessor in title could not validly transfer the right to improve subaqueous lands separate from the upland, as was done here, until after the right to reclaim had been exercised. (Scott-Fla)
W69-02733

## YARA ENGINEERING CORP V N J TURNPIKE AUTHORITY (OWNERSHIP OF CREEK BED).

49 N J Super 603, 141 A 2d 66-68 (1958).

Descriptors: \*New Jersey, Judicial decisions, \*Ownership of beds, Beds, Streams, Streambeds, \*Tidal waters, Tides, \*Navigable waters, Fishing, Flow, Water rights, Non-navigable waters.

Plaintiff brought an action for declaratory judgment contending that title to a creek bed was good as against the defendant, who held title under a grant from the state. From a summary judgment entered by the Law Division in the defendant's favor, the plaintiff appealed. The Superior Court affirmed, holding that the State was the owner of land within the boundaries of a creek ordinarily flowed by tide water even if the creek was not a navigable stream or suitable for fishery. The test to be followed in New Jersey in determining the State's sovereignty over submerged lands is the tidal test only. (i e, whether the waters are effected by the ebb and flow of the tide). (Watson-Fla) W69-02735

## STATE V DAKOTA COUNTY (TITLE TO LAND BELOW HIGH WATER MARK), 93 NW 2d 595-600 (lowa 1958).

Descriptors: \*Iowa, Judicial decisions, Boundaries (Property), \*Riparian waters, State governments, Low water mark, \*Ownership of beds, Watercourses (Legal), High water mark, \*Navigable rivers, Navigable waters, Rivers, Riparian rights.

The State of Iowa filed a petition asking specific performance of a contract by defendants to convey a tract of land along a river to plaintiff. The land extended to the low water mark along the river. Defendants counterclaimed, and asked that title be quieted in them. The court held that land between the low water mark and the high water mark on a navigable stream belonged to the state as a matter of law. The state holds the title to soil below the high water mark in trust for navigation and commerce. (Scott-Fla) W69-02736

## CITY OF EUSTIS V FIRSTER (RIPARIAN RIGHT TO UNOBSTRUCTED VIEW), 113 So 2d 260-263 (2d DCA Fla 1959).

Descriptors: \*Florida, Judicial decisions, \*Cities, Water law, \*Navigable waters, \*Riparian rights, Piers, Lakes, Legislation, Riparian land.

Plaintiff sought a mandatory injunction requiring the defendant city to remove certain structures which obstructed plaintiff's view of adjoining

#### Nonstructural Alternatives — Group 6F

waters. The court noted that a conveyance of uplands bounded by navigable waters carries with it riparian rights to the water. Under Florida law, the right of an upland owner to an unobstructed view of adjoining waters is a riparian right. However, plaintiff was barred by laches from suing for a mandatory injunction, 10 years having passed between acquisition of title and initiation of the suit. The structures complained of had existed 25 years when plaintiff bought his property. (Childs-Fla) W69-02737

# CARMAZI V BOARD OF COUNTY COMM'RS OF DADE COUNTY (RIPARIAN RIGHT OF AC-CESS FOR NAVIGATION). 108 So 2d 318-324 (3d DCA Fla 1959).

Descriptors: \*Florida, Judicial decisions, \*Riparian rights, Damages, Dams, Navigable waters, Administrative agencies, United States, Legislation, Access, \*Navigation, \*Eminent domain, Flooding, Identifiers: \*Flood Control Act.

Appellant Carmazi brought suit to adjudicate property rights and recover for damage to his riparian land as a result of dam construction on a navigable stream. However, the court held that there was no showing of abuse of administrative discretion in selection of the site for the proposed dam. The right of navigation is common to the public in general and riparian owners acquire no additional rights to navigation other than those shared concurrently with the public. Eminent domain statutes protect only private rights. The proposed construc-tion was justified as a necessary exercise of police power for the benefit of all, and the rights of those affected by exercise of such governmental function must give way to the benefits which accrue to the public as a whole. (Childs-Fla) W69-02738

#### HARTFORD V TOWN OF GILMANTON (AC-CESS ROAD TO PUBLIC LAKE).

146 A 2d 851-855 (N H 1958).

Descriptors: \*New Hampshire, Boundaries (Property), \*Easements, Judicial decisions, Leases, Local governments, Ownership of beds, Public rights, Recreation, \*Shores, Right-of-way, \*Roads, Access routes, Highways, Relative rights, Lakes, Ponds, Beaches, Lake shores, High water mark, Legal aspects, Eminent domain, Parks. Identifiers: Loon pond.

Plaintiff brought suit to determine title and rights in certain land located within the limits of a public road which ran to and beyond a public lake. The dispute concerned a strip of beach between the traveled way and the water's edge. Being a public lake, any member of the public could exercise a common law right to boat, bathe, fish, skate, and cut ice in and on its waters. The court found that the road had not been abandoned nor its use discontinued; therefore, any member of the public could use the road to reach the waters. The court held, however, that the public did not have the right to use privately owned shore front property. (Plaintiffs owned the shore front property up to the high water mark of the pond). Further, the public could not park on the public road for the purpose of recreational use of the pond, since such parking would not be incident to a viatic use of the right-ofway and would therefore not be within the original purpose of the easement granted for the road. (Scott-Fla)
W69-02739

#### GRATTO V PALANGI (USE OF GREAT PONDS).

147 A 2d 455-460 (Me Sup Jud Ct 1958).

Descriptors: \*Maine, Judicial decisions, Water law, \*Great ponds, Lakes, Swimming, Boating, Beaches, \*Recreational facilities, Safety. Plaintiff, a child, brought a companion action for injuries sustained by her when she was struck by a motorboat while bathing at defendant's public bathing beach on a great pond. Under the great pond rule, the defendant had no possession or control of the swimming area because the waters are public waters. The beach proprietor could not prevent boats from entering the swimming area. Swimming and boating are obvious uses of great ponds, and a swimmer must share the use of them with boats. The defendant was found not negligent. (Childs-Fla) W69-02740

### COCANIG V CITY OF CHICAGO (WATER SUPPLY). 21 111 2d 464, 173 NE 2d 482-485 (1961).

Descriptors: \*Public utilities, \*Water supply, Land governments, \*Legislation, Remedies, Legal aspects, Judicial decisions, Cities, \*Domestic

The plaintiff homeowners brought action to enjoin the City of Chicago from shutting off their water supply. The controversy arose over a water bill that was not paid by a former owner. The court held that the landowners were not liable for the bill and that the city could not turn off the water supply. The city could have followed procedures set forth in a city ordinance for collection of the bill, but it did not. Cutting off water to the present owners is a remedy unavailable to the city. (Horner-Fla) W69-02742

## STATE V CITY OF AKRON (WATERCRAFT

168 NE 2d 500-504 (Ohio C P 1960).

Descriptors: \*Judicial decisions, \*Ohio, Reservoirs, Cities, Beds, Legislation, \*Permits, \*Boating regulations, Boats, Ownership of beds, Local governments.

Ohio brought suit against the city of Akron to permanently enjoin it from requiring licenses to be purchased by boatowners using the city waterworks reservoirs. The state relied upon a statute requiring state licensing of watercraft and precluding any political subdivision of the state from charging any fee for such. The city answered by saying that the statute as it applied was unconstitutional as a taking of private property without compensation and due process and as a restriction on the constitutional right of a municipal corporation to own and operate a public utility. The court held for the city and declared the Watercraft Act unconstitutional and void as applied in this situation. Property which a municipality operates in a proprietary capacity is to be treated as private property. The city owned the bottoms of the reservoirs, and since they were impounded from non-navigable streams, it had exclusive control of the waters. Thus, the statutory restriction was a taking of an incident of ownership or property right. The court also agreed that the statute was in conflict with a municipality's constitutional right to operate a public utility. (Williams-Fla) W69-02743

## JACKSON V CITY OF MADISON (LAKE BEDS). 12 Wis 2d 359, 107 NW 2d 164-169 (1961).

Descriptors: Permits, \*Legislation, State governments, Local governments, \*Wisconsin, \*Owner-ship of beds, Submerged beds, Legal aspects, City planning, Lakes, \*Lake beds, Recreation facilities, Land reclamation, Boundaries (Property), Water law, Judicial decisions, Cities, Navigable waters. Identifiers: \*Lake Monoma.

This is a taxpayer's action for a declaratory Inis is a taxpayer's action for a declaratory judgment on issues involving an auditorium and parking ramp which the city proposes to build on filled in land in Lake Monoma. The issues before the court were: (1) whether it would be a gross abuse of discretion by the Madison City Council to spend \$5,500,000 to build the auditorium and parking ramp on the bed of Lake Monoma, which was owned by the state and for the use of which the state had granted to the city only a revocable permit, and (2) whether existing statutes prohibited such construction. The court held that the Madison City Council had the state's permission to construct the facilities and that it was not an abuse of discretion simply because the state could divert the site to another public purpose sometime in the future. With respect to the second issue, the court held that the access provided by the proposed project was consistent with the legislative intent of the relevant statuatory provisions. (Smith-Fla) W69-02744

### SZESTOWICKI V WATER RESOURCES COMM'N (REQUEST FOR PERMIT TO EX-TEND PIER).

156 A 2d 197-200 (Conn 1959).

Descriptors: \*Water Resources Commission, \*Piers, Navigable water, \*Docks, \*Piles, Dredging, Harbor improvements, Administrative proceedings, Permit, Navigation, Shoreline, Shores, Connecticut.

The owner of upland, which fronted on a small semicircular cove on a river, sought permits for the construction and extension of two lines of piers, piles, and accessory floats, for a distance of 400 feet from the shoreline and for certain dredging in the river in connection therewith. The Water Resources Commission found that the proposed construction would reach into navigable water and would interfere with navigation and access to neighboring piers. The court found on review that the commission's findings were neither arbitrary nor unreasonable, and therefore affirmed the denial of the permits. (Rief-Fla) W69-02745

#### 6F. Nonstructural **Alternatives**

#### WISCONSIN'S SHORELAND AND FLOOD PLAIN PROTECTION PROGRAM, Wisconsin Bureau of State Planning, Madison.

Donald F. Wood.

Water Resources Research, Vol 4, No 6, pp 1375-1379, December 1968. 5 p, 4 ref.

Descriptors: Wisconsin, \*Flood protection, \*Shore protection, Water management, Zoning, Building codes, Benefits, Costs, Water pollution, Adminis-

Identifiers: Regional planning agencies, Sanitary codes, Water resource problem, Shoreland protection, Flood plain protection.

The State of Wisconsin has undertaken a bold program of regulating shoreland and flood plain uses in an attempt to overcome certain water resources problems. The program is too new to have its effectiveness evaluated. Nonetheless, in future years the program's success and shortcomings deserve considerable attention by all persons concerned with water resource management. (Seneca-Rutgers) W69-02550

# PERCEPTION OF FLOOD HAZARD IN A SMALL NEW JERSEY TOWN, Rutgers-The State Univ., New Brunswick, N. J.

Jacquelyn Beyer.
Proceedings of the Third Annual American Water
Resources Conference, 1967, pp 415-435. 21 p, 10

Descriptors: \*Flood damage, Flood plains, Flood, Flood control, Flood protection, New Jersey, Flood

Pload control, Flood protection, New Jersey, Flood plain insurance, Decision making. Identifiers: \*Flood hazard perception, \*Blairstown, Soil Conservation Service, Certainty-uncertainty continuum, Information dissemination.

## Field 06—WATER RESOURCES PLANNING

## Group 6F—Nonstructural Alternatives

Flood damages affect a broad range of occupiers of flood hazard areas. Planners need to know as much as possible about how decisions concerning the flood hazard are made. This study considers the intiood nazard are made. This study considers the in-dividual's decision making process in one commu-nity on a small tributary stream. A major recom-mendation for change in current management pol-icy is for improved flood hazard information, including information about the range of possible adjustments. It would be useful to be able to measure the potential effectiveness of such information in given areas. One such measure has previously been suggested in the form of a certainty-uncertainty scale. Blairstown can be ranked on the scale as high in uncertainty. This indicates a high degree of dif-ficulty in disseminating more complex and/or more complete information. There are, however, opportunities for exploiting latent interest in floodproofing and in clarifying misconceptions about the role of insurance. More emphasis on regulation might also be useful. Timing of information becomes critical where the restraints of experience are so intense. (Seneca-Rutgers) W69-02554

WATER MANAGEMENT IN CENTRAL AND

SOUTHERN FLORIDA, Central and Southern Florida Flood Control Dis-

trict. G. D. Dail, Jr.

Florida Planning and Development, Vol 19, No 6, June 1968, p 1, 8-11.

Descriptors: \*Water resource management, \*Flood control, Recreation, Administrative decisions, Adoption of practices, River basin planning, Wilconservation, Preservation, Public benefits, \*Administrative agencies, Recreation demand, Water districts, State governments, Project

planning.
Identifiers: Kissimmee River Basin, Upper St. Johns
River Area, The Everglades, Central and Southern
Florida Flood Control Project, Florida.

In the initial settlement many water management problems confronted the settlers in central and southern Florida. Floods threatened the continued habitation of certain areas, but all efforts by state and private enterprise during the late 19th and early 20th centuries to drain flood waters from the interior proved inadequate. Following a gigantic flood which inundated more than five million acres, the State of Florida finally began flood control. In 1948 the Central and Southern Florida Control 1948 the Central and Southern Florida Control Project was initially authorized by Congress. The Flood Control District, comprising these areas, was created in 1949 by the Florida legislature and given the responsibility of cooperating with the Federal government in building the system. Today the Federal Control District is operating and maintaining a system that includes about 1,500 miles of canal and levees, pumping stations, and more than 75 large spillways and dams. The system is unique in providing flood control by conservation, the Kissimmee Basin, Upper St. Johns River area, and Everglades are major areas in the Flood Control District water management projects. A byproduct of this has been the creation of vast areas which are available to the public for recreational purposes available to the public for recreational purposes and wildlife conservation. (Gargola-Chicago) W69-02800

#### 07. RESOURCES DATA

#### 7A. Network Design

DIGITAL TRANSMISSION OF COLLECTED

WATER QUALITY DATA,
Arkansas Univ., Little Rock. Dept. of Electronics and Instrumentation.

For primary bibliographic entry see Field 05A. For abstract, see . W69-02406

WATER LEVEL FLUC EVAPOTRANSPIROMETERS, **FLUCTUATION** IN Geological Survey, Phoenix, Ariz.

For primary bibliographic entry see Field 02D. For abstract, see . W69-02569

#### 7B. Data Acquisition

ELECTROCHEMICAL TRANSDUCERS FOR

WATER QUALITY, Arkansas Univ., Little Rock. Dept. of Electronics and Instrumentation.

For primary bibliographic entry see Field 05A. For abstract, see . W69-02407

## CIRCULATION AND MIXING PROCESSES IN

LAKES, Wisconsin Univ., Madison. Water Research

For primary bibliographic entry see Field 02H. For abstract, see . W69-02489

## CALIBRATION AND EVALUATION OF A WIDE-RANGE GRAVIMETRIC METHOD FOR MEASURING MOISTURE STRESS,

Geological Survey, Denver, Colo. Irel S. McQueen, and Reuben F. Miller. Soil Sci, Vol 106, No 3, pp 225-231, 1968. 7 p, 1 fig, 2 tab, 14 ref.

Descriptors: \*Soil moisture, \*Soil moisture meters, \*Moisture tension, \*Instrumentation, Calibrations, Soil water, Wettability, Hydrologic properties,

Methodology. Identifiers: \*Stress sensor, Filter paper, Filters.

A method of determining the soil moisture stress of field samples by sealing pieces of filter paper into the sample container but not in contact with the sample is described. The samples and paper discs are allowed equilibrate at 20 deg C for at least a week. Samples must be handled with care; grain rearrangement changes moisture stress without change in water content. After equilibration the paper is accurately and rapidly weighed. Moisture stress may be computed from the moisture content of the filter paper or it may be obtained from a calibration plot. The method is effective over a stress range of 0.001 to 1,500 bars. The accuracy is as good as or better than that of other commonly used methods. (Knapp-USGS) W69-02509

#### POLLUTION SURVEILLANCE BY NONCON-TACT INFRARED TECHNIQUES,

Texas Instruments, Inc., Dallas.
J. R. Van Lopik, G. S. Rambie, and A. E. Pressman.

J Water Pollut Contr Federation, Vol 40, No 3, Part 1, pp 425-438, Mar 1968. 14 p, 14 fig, 10 ref.

Descriptors: \*Remote sensing, \*Path of pollutants, \*Water pollution, \*Monitoring, Surveys, Pollutants, \*Water pollution, \*Monitoring, Surveys, Pollutant identification, Assessments, Instrumentation, Methodology, Texas. Identifiers: \*Infrared techniques, Galveston Bay.

Airborne infrared mapping techniques and their application to identification and monitoring of polapplication to definite and other bodies of water are described and illustrated. Thermal, organic and inorganic pollution can be determined and monitored, thus providing for rapid means to make ontored, thus providing for rapid means to make on-the-ground measurements and, with aerial surveys, synoptic assessments of pollution parameters. In-frared mapping methods show the differences in in-frared radiation flux over the area mapped. Sensing of temperature by this means can be used to map isotherms in water bodies and to trace thermal pollution, such as has been done in Galveston Bay. Proper selection of wavelengths allows identification of contaminants by their spectral emissivity characteristics. (Lang-USGS) W69-02516

#### ULTRAVIOLET ABSORBANCE AS AN INDEX ( OF THE POLLUTION OF SEAWATER,

Tokyo Metropolitan Univ. (Japan). Norio Ogura, and Takahisa Hanya. J Water Pollut Cont Federation, Vol 40, No 3, Part t 1, pp 464-467, Mar 1968. 4 p, 5 fig, 1 tab, 7 ref.

Descriptors: \*Indicators, \*Water pollution, \*Sea water, \*Ultraviolet radiation, Spectometer, Chemical oxygen demand, Turbidity.
Identifiers: \*Spectometry, Ultraviolet adsorption, Tokyo Bay.

A study of several bays in Japan shows that ultraviolet absorption can be used effectively as an indicator of organic pollution in coastal waters. Coastal seawater is subject to pollution by drainage from the land and by wastes from ships. Transparency and chemical oxygen demand often are used as criteria to determine pollution. Absorbance of seawater is due mainly to organic matter and bromides, and absorbance of coastal water is higher than that of the open sea. Drainage from the land lowers the bromide absorbance but raises the absorbance attributable to organic matter. An increase in chemical oxygen demand and a decrease in transparency accompany increases in non-bro-mide absorbance. (Lang-USGS) W69-02517

# A COMPOSITE-GRAB OF WATER POLLU-TION CONTROL SAMPLING, Iowa State Water and Pollution Control, Ames.

Robert F. Roskopf.

J Water Pollut Cont Federation, Vol 40, No 3, Part 1, pp 492-498, Mar 1968. 7 p, 9 ref.

Descriptors: \*Sampling, Water pollution control, Sewage treatment, Water treatment, Monitoring, Instrumentation, Statistical methods, Industrial

Identifiers: \*Sampling types, Basic data.

Sampling, an often misunderstood but very important part of water pollution control activities, is discussed. Factors that complicate the obtaining of discussed. Factors that complicate the obtaining of representative samples include place of sampling, timing of sampling, flow metering, and sample preservation. Sampling is necessary in the control of industrial wastes, wastewater treatment plant design, plant operation, and control of stream pollution. An effective sampling program will have well-defined objectives and scope, be worth the money invested in it, and be designed with due reard for laboratory and other presents. gard for laboratory and other personnel, suitable equipment, and safety. Statistics should be used for signing the program and interpreting its results. Adequate but concise records are important. (K-napp-USGS)
W69-02519

#### INSTRUMENTS FOR MEASURE-LASER

General Precision Systems, Inc., Pleasantville, N.

R. A. Flower. Mech Eng, Vol 90, No 10, pp 27-31, Oct 1968. 5 p, 2 fig, 19 ref.

Descriptors: \*Measurement, \*Measuring instruments, \*Laser, Alinements, Cargon dioxide, Bibliographies, Rotation, Interferometers, Spectroscopy, Velocity meters, Optical instruments, Surveying, Surveying instruments, Water measurement, Plasma physics, Direction finding, Chemical analysis: Altimeters analysis, Altimeters.

Identifiers: Gyroscopes, \*Optical measurements, Doppler effect.

The laser has greatly improved optical measurement techniques for distance, velocity, departure from reference axis, angular rotation, and other uses in alinement and linear measuring. Laser echo ranging systems are comparable to microwave radar ranging systems in maximum range and accuracy, and have advantages in situations requiring extremely narrow transmitting beam widths. Laser

Data Acquisition—Group 7B

interferometers have a theoretical capability to operate with path length differences of hundreds of miles as compared to path lengths of several feet for conventional optical interferometry. Alinement measurements are possible over long distances, even in direct sunlight, due to the intensity and narrowness of the laser beam. Velocity measurements may be made by Doppler shifts or by detecting the motion of the random diffraction pattern produced by laser scattering from a moving target surface. Some potential future laser applications include a rotation sensor or laser gyroscope, absorption spec-troscopy for identifying chemical elements, determining carbon dioxide content in a gaseous mixture by an optical resonance method, and measuring electron density of a plasma by determining the dielectric constant of a region from the medium's optical wave length via the laser interferometer technique. (USBR)
W69-02577

## SEMI-QUANTITATIVE DETERMINATION OF GROUNDWATER QUALITY FROM SURFACE ELECTRICAL MEASUREMENTS,

Huntec Ltd., Toronto (Ontario).

Tsvi Meidav.

Soc Explor Geophys 35th Annu Meet, Dallas, Tex. Nov 1965. 18 p, 4 fig, 6 ref.

Descriptors: \*Groundwater, \*Water quality, \*Salinity, Measurement, \*Electrical resistivity, Arid land, Aquifers, Porosity, Rocks, Wells, Permeability, Hydrology, Geology, Evapotranspiration, Alluvial deposits, Water table, Phreatic line, Alluvial streams, Nomographs, Conductivity, Foreign regards by Foreign research.

Identifiers: Iran, Geoelectricity, Groundwater hydrology, \*Groundwater quality.

Determining the ground-water quality of alluvial beds from surface geoelectrical measurements is complicated by the fact that measured resistivity is a function of many factors, such as the ratio of clay to combined sand and gravel, porosity, percent saturation, and water salinity. Relationships among total sample resistivity, saturating liquid resistivity, and texture of the soil and rock are discussed; empirical equations are given. The study, made in arid regions of Iran, indicates that an inverse relationship exists between ground-water salinity and apparent resistivity measured on the ground surface.
The linear factor, determined by correlation with known conditions, was successfully employed to predict the presence of a confined sweetwater aquifer underlying a highly saline phreatic aquifer. A nomogram is presented for determining formation factors and converting surface resistivity to sodium chloride equivalents for a given formation factor. Accuracy for determining ground-water conductivity depends upon the constancy of the formation factor through the investigated region. (USBR) W69-02594

#### REFLECTION SEISMICS IN ENGINEERING GEOPHYSICS,

Huntec Ltd., Toronto (Ontario).

Tsvi Meidav.

Soc Mining Eng AIME, Minneapolis, Minn, Sept 1968. 35 p, 18 fig, 7 ref.

Descriptors: \*Geophysics, \*Seismic investigations, Seismic waves, Wave velocity, \*Seismographs, Explorations, Engineering geology, Wave length, Subsurface investigations, Geologic investigations, Instrumentation, Reflection, Longitudinal waves, Transverse waves, Geophones. Identifiers: Foreign products, Canada, \*Seismic

reflection.

The seismic reflection method has many advantages over the seismic refraction method, but has not been exploited in engineering geophysics. The advantages are based on richness of subsurface detail, absence of restrictions from blind zones or hidden layers, and no encumbrances as the refrac-tion method's requirements for a receiver spread to

be many times longer than the deepest refractor. The main problem in exploiting the reflection method in engineering geophysics is separation of the superimposed waves at short record times. Velocity filtering removes undesirable waves, leaving a substantial usable reflection even at short record times. Special circuitry has been developed to sense the time lag of positive zero crossings of the signal at 2 separate geophones, and to record only arrivals having a phase shift smaller than an ar-bitrarily set amount. Fundamentals of analysis for an expanding reflection spread are reviewed. Field examples demonstrate the abilities and limitations of the present technique. (USBR) W69-02595

#### AIRPHOTO INTERPRETATION AS AN AID IN LOOD SUSCEPTIBILITY DETERMINATION.

Department of Energy, Mines and Resources, (Canada).

Lawrence C. N. Burgess.

Int Conf Water Peace, Washington, D C, May 1967. 16 p, 1 tab, 12 ref.

Descriptors: \*Aerial photography, Photography, Photographs, Erosion, \*Flood plains, Flood damage, Vegetation, Sedimentation, Vegetation, damage, vegetation, Sedimentation, Geomorphology, Land management, Water utilization, Water resources, Meteorological data, Watersheds (Basins), Topography, \*Flood plain zoning, Floodwater, \*Flood forecasting. Identifiers: Flood estimate, \*Photointerpretation.

Airphoto interpretation is an effective method of obtaining unique flood susceptibility information. perceptive interpretation of available aerial photographs, the extent, nature, and relative frequency of floods can be determined. Special photography during flooding or subsequent to a major flood is not required to obtain these results. While effects of major floods are obvious, occurrence of consecutive minor floods leaves distinct indicators on the flood plain. Cumulative effects of all overbank flow may be detected directly from observable natural and cultural features, and indirectly by inferences drawn from adjustment of man and vegetation to flood plain conditions. Clues that indicate flood susceptibility may be used either singly or grouped to determine the potential of an area for erosion, sedimentation, extremes in flood velocities, and duration and extent of inundation. Areas subject to destructive water-current velocities (heavy sedimentation and slack-water inundation) can be delineated to plan for the most effi-cient flood plain land use. Resolving resource-use conflicts, such as between flood control measures and recreation values, or between irrigation and other water use, can be facilitated through airphotos to provide a broad perspective of watershed conditions. (USBR)

# THE MEASUREMENT OF LOW FLUID VELOCITIES WITH THE AID OF A TETHERED SPHERE,

Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.

Hydraulic Lad. Heinz Stefan, and Frank R. Schiebe. Water Resources Res, Vol 4, No 6, pp 1351-1357, December 1968. 7 p, 6 fig, 1 tab, 1 ref.

Descriptors: \*Instrumentation, \*Current meters, \*Hydraulic models, Laminar flow, Turbulent flow, Open channel flow, Model studies, Laboratory tests.

Identifiers: Low velocity fluid flow, Tethered sphere current meter.

Two- or three-dimensional velocity fields in hydraulic models can be measured with the aid of a tethered sphere if the absolute velocity values are very small. The apparatus is relatively simple and quite sensitive. Experimental data can be handled numerically, taking into account all effects, and printout is readily available in useful tabular or graphical form. The greatest disadvantage at present seems to be that the position of the

tethered sphere is not stable, and it is difficult to define when turbulence is present in the flow. The average position of the sphere will most probably not correspond to the velocity average in this case. This disadvantage is, however, shared by most velocity measuring devices with low frequency response. The second inaccuracy is that the program presently available is based on the assumption that the velocity is uniform over the height of the probe. The development of a new program taking into account continuously varying velocity and temperature profiles is in progress. It is of particu-lar importance for small spheres on long support lines. The instrument may also be inverted by using a sphere slightly heavier than water. Such an instrument would be suitable for velocity measurements near the bottom of a channel. W69-02668

# DENSITY AND MOISTURE CONTENT MEA-SUREMENTS BY NUCLEAR METHODS, Research Triangle Inst., Durham, N. C. R. P. Gardner, and K. F. Roberts.

Nat Coop Highway Res Program Rep 43, 38 p, 1967. 14 fig, 23 tab, 3 append, 9 ref, and list of 42 pub rep on highway res.

Descriptors: \*Soil moisture meters, \*Soil density probes, \*Nuclear moisture meters, \*Calibrations, On-site tests, Methodology, Instrumentation. Identifiers: \*In situ calibration, Air-gap calibration, Dual-gage calibration, Nuclear soil moisture meters, Calibration handbooks.

A method is presented for calibration of nuclear soil-moisture gauges to make consistent, reproduci-ble, accurate field soil moisture and soil density measurements. Nuclear moisture meters are sensitive to soil composition, poor calibration techniques, and soil density. Calibration models were developed and curves drawn to enable stable homogeneous non-soil calibration standards to be used. Standards and models for each available type of gauge were found and tested. A dual-gauge compensation for soil composition variation was developed. The model developed explains and optimizes the air-gap method of using this principle. It is concluded that this calibration method should be used with the air-gap method for field use with commercially available nuclear density meters. The calibration method for each available meters. The calibration method for each available meter is explained in a handbook included in 2 appendices. (Knapp-USGS)
W69-02676

# RADIOACTIVE TRACING OF STORM RUNOFF ON A SMALL CATCHMENT I EXPERIMEN-TAL TECHNIQUE, New South Wales Univ., Kensington (Australia).

School of Civil Engineering.

For primary bibliographic entry see Field 02E. For abstract, see. W69-02769

RADIOACTIVE TRACING OF STORM RUNOFF ON A SMALL CATCHMENT II DISCUSSION OF RESULTS, New South Wales Univ., Kensington (Australia).

School of Civil Engineering.

For primary bibliographic entry see Field 02E.

For abstract, see . W69-02770

#### TRITIUM MEASUREMENTS IN NATURAL HAWAIIAN WATERS: INSTRUMENTATION, Hawaii Univ., Honolulu. Water Resources Research Center.

Water Resources Research Center, Tech Rpt No 22, Nov 1968. 36 p, 13 fig, 2 tab, 40 ref. OWRR Project A-016-Hi.

Descriptors: \*Tritium, Hawaii, Liquid scintillation, Electrolysis, Rainwater, Surface water, Ground water, Ocean water. Identifiers: \*Instrumentation, Water.

#### Field 07 - RESOURCES DATA

#### Group 7B — Data Acquisition

All known tritium measurements made of Hawaii rainwater, ocean water, surface water, and ground water are summarized. Ocean water yielded 10 to 20 T.U. in 1963-65. Tritium in rainwater rose from a low 6 T.U. in 1961 to a 1963 summer peak of 373 T.U., exhibited strong seasonal fluctuations, and declined to 43 T.U. in mid-1965. Ground water samples collected in late 1966 on Oahu ranged between 24 to 0.5 T.U. Ground-water samples with high tritium count were taken from high-level water; those with considerably less tritium were basal water and the one with the least tritium was basal water farthest down gradient and below a 1100-foot caprock in Ewa Beach, Oahu. The facilities of the Tritium Laboratory at the University of Hawaii are described. The present basic unit for tritium analysis utilizes liquid scintillation with electrolysis for enrichment of low-level samples.

### AN OPTIMIZATION SCHEME FOR GAGING.

Harvard Univ., Cambridge, Mass. Myron B, Fiering. Water Resources Res, Vol 1, No 4, pp 463-470, 4th Quart 1965. 8 p, 8 tab, 8 ref.

Descriptors: Correlation analysis, Data collections, Digital computers, Distribution patterns, Discharge measurement, \*Gaging stations, Hydrologic data, Least squares method, Mathematical models, \*Optimization, Regression analysis, River flor\* \*Sampling, \*Statistical methods, \*Stream gages. Identifiers: Nonlinear integer programming

The conjunctive use of nonlinear integer programming and principal component analysis was suggested for specification of a constrained optimal gaging program whose objective was to define efficient estimates of the several annual means. The assumptions in the analysis were that data from all the study sites were available for a certain number of years, and a certain number of years of additional gaging was contemplated. The observations were presumed to derive from a multivariate normal population with no serial correlation. The specified which sites from among the original observation sites should be continued, and which should be estimated by linear regression. It was concluded that for systems where the number of sites exceeded 5, a digital computer would be required to identify the constrained optimums. Although the discussion was directed toward hydrologic applications, it was stated that the technique is generally applicable to sampling surveys. (Gysi-Cornell)
W69-02791

#### 7C. Evaluation, Processing **AND Publication**

ESTABLISHMENT OF WATER QUALITY LABORATORY AND SYSTEM FOR STORAGE AND RETRIEVAL OF INFORMATION, South Dakota State Univ., Brookings.
John L. Wiersma.

Technical Completion Report to Office of Water Resources Research, Department of the Interior, November 1968, Washington, D. C., 16 p. OWRR Project A-009-SDak.

Descriptors: Laboratories, \*Research facilities, Data collections, \*Data storage and retrieval, \*Information retrieval, Computer program, Water analysis, Laboratory tests.

A laboratory facility which would provide an adequate centralized unit for research and training in the area of water quality has been established in cooperation with other units of the South Dakota State University. The laboratory is now equipped with modern facilities with capability of making nearly all chemical and biological analyses needed in water research. The water quality data collected from this laboratory and laboratories within the State has encouraged the establishment of a storage and retrieval system of water quality data. The system is known as the 'SODAK' System, which ac-

cepts data in raw form without dictating the form of laboratory analysis sheets and converts the data to a uniform format. The system has three programs: (1) The translator program, (2) the sorter program, and (3) the logic selective search program. The translator program supplies proper coding of supplied data. The sorter program processes the translated stored data as required by the selective search program. The selective search program is supplied by the potential user and is built around the logic statements 'IF', 'AND IF', 'OR IF', and 'SAVE', thus allowing the user to construct a search routing that satisfies his needs by selection or rejection of any stored data. W69-02468

## WATER-LEVEL TRENDS IN SOUTHEASTERN

LOUISIANA, Geological Survey, Baton Rouge, La. Water Resources Div.

For primary bibliographic entry see Field 02F. For abstract, see . W69-02513

#### SURVEY OF PROGRAMS FOR WATER-SUR-FACE PROFILES,

Corps of Engineers, Sacramento, Calif. For primary bibliographic entry see Field 08B. For abstract, see . W69-02556

#### LABORATORY EVALUATION OF SELECTED RADIOISOTOPES AS GROUND TRACERS,

Texas A and M Univ., College Station. A. Ray, Jennings, and Melvin C. Schroeder. Water Resour Res, Vol 4, No 4, pp 829-838, Aug 1968. 10 p, 2 fig, 3 tab, 16 ref.

Descriptors: \*Tracers, \*Radioactive isotopes, Groundwater, Half life, \*Groundwater flow, Aquifers, Velocity, Laboratory tests, Bibliographies, \*Groundwater movement, Water measurement, Shales, Limestones, Strontium radioisotopes, Ion exchanges

Identifiers: Chromium radioisotopes, Ruthenium radioisotopes, Cerium radioisotopes, Chelating

An ideal ground-water tracer, moving at the same rate as the water, does not exist for use in all types of aquifers. Laboratory tests can give some indication of the suitability of a tracer under particular conditions before field tests. Antimony 121, cerium 141, chromium 51, indium 114, ruthenium 103, and strontium 85 were tested in chelate form. Ion exchange measurements were made under static conditions for crushed illitic shale and limestone, and used to predict the elution history of a tracer from an exchange column. Comparing predictions, tracer elution histories, and elution histories for chloride pulses indicates that chelated chromium 51 is an adequate ground-water tracer. Average ground-water velocity is equal to the sum of tracer velocity plus the product of tracer velocity, distribution coefficient, and bulk density of the aquifer divided by effective porosity. An ideal tracer has a zero coefficient of distribution and an average velocity equal to the average ground-water velocity. The best index for determining average water velocity is the arrival of the maxium tracer concentration, resulting from movement along the most direct flow path. (USBR) W69-02571

### A LAG-DEVIATION METHOD FOR ANALYZ-ING CHANNEL BED FORMS, Agricultural Research Service, Oxford, Miss. Sedi-

For primary bibliographic entry see Field 02J. For abstract, see . W69-02670

ELECTRICAL-ANALOG ANALYSIS OF HYDROLOGIC DATA FOR SAN SIMON BASIN COCHISE AND GRAHAM COUNTIES, ARIZONA,

Geological Survey, Washington, D. C. For primary bibliographic entry see Field 02F. For abstract, see . W69-02678

## SYNTHESIZING DAILY DISCHARGE FROM RAINFALL RECORDS,

Geological Survey, Carson City, Nev. Donald O. Moore.

ASCE Proc, J of Hydraul Div, Vol 94, No Hy5, Pap 6119, pp 1283-1298, Sept 1968. 16 p, 11 fig, 5 tab,

Descriptors: \*Hydrographs, \*Synthetic hydrology, \*Streamflow forecasting, Unit hydrographs, Bas flow, Precipitation (Atmospheric), Runoff, Hydro-graph analysis, Recession curves, Methodology. Identifiers: Hydrograph synthesis, Daily discharge synthesizing.

A graphical method of synthesizing hydrographs of daily mean streamflow from precipitation records is described. The method described requires four distinct operations: (1) Determination of the mean depth of daily precipitation over the drainage basin, (2) determination of the precipitation excess, (3) determination of the time distribution of each increment of storm runoff, and (4) determination of the amount of base flow that should be added to the direct runoff to give to total flow. The method has produced good results, where it has been tested, in forecasting flood hydrographs from precipitation. W69-02694

#### 08. ENGINEERING WORKS

#### 8A. Structures

#### SOUTH RIVER TIDAL DAM PROJECT, SPE-CIAL REPORT 21.

New Jersey State Dept. of Conservation and Economic Development.

For primary bibliographic entry see Field 04B.

For abstract, see. W69-02506

## ADVANCED PIPELINE TECHNOLOGY FOR

IRRIGATION PROJECTS, United Technology Center, Sunnyvale, Calif. Allen Porter.

Space Age Irrig Symp, Huron, S Dak, June 1968. 31 p, 6 fig, 4 tab, 2 append.

Descriptors: Pipelines, \*Pipes, \*Water pipes, Reinforcing, Composite materials, \*Mortars, Glass fibers, Plastics, Costs, Chemical properties, \*Closed conduits, Mechanical properties, Hydraulics, Irrigation systems, Plastic pipes, Materials. Identifiers: Polyesters, Thermosetting plastics, \*Fiberglass plastic pipes, Glass reinforced plastics, \*Reinforced plastic mortar pipe.

Reinforced plastic mortar (RPM) pipe, a comreinforced plastic mortar (KFM) pipe, a com-posite material made of a synthetic resin-sand mor-tar with fiberglass reinforcement, is designed specifically for water and waste conveyance systems for agricultural and domestic use. The manufacturing process is discussed and pipe con-figurations are given. Mechanical properties, hydraulic characteristics, chemical inertness, and hydraulic characteristics, chemical inertness, and design considerations are covered. In addition to testing programs sponsored by the developer of the pipe, independent tests are being conducted by the National Sanitation Foundation for toxicology, and the Bureau of Reclamation for hydraulics, structural strength, and durability. Draft specifications have been prepared by ASTM, and testing by Underwriters Laboratories will begin soon. Applications have included installing thin-wall RPM pipe inside an existing failed concrete irrigation main, and converting an open canal to a closed conduit system. Initial costs appear economically attractive as size and working pressure increase, particularly in sizes above 15-in. dia. Cost savings are possible in installing RPM pipe because of its lightweight and superior handling characteristics, and because favorable hydraulic characteristics may allow using smaller-diameter pipe. (USBR) W69-02559

CBA Engineering Ltd., Vancouver (British Columbia); and Cementation Co. Ltd., Rickmansworth

J. W. Gadsby, and F. A. Bares. Can Geotech J, Vol 5, No 3, pp 127-141, Aug 1968. 15 p, 10 fig, 3 tab, 10 ref.

Descriptors: \*Cofferdams, \*Cutoff walls, Cutoffs, \*Granular materials, Cutoff trenches, Slurries, Bentonites, Foreign construction, Impervious materials, Hydraulic structures, Construction, Grouting, Cores, Geology, Costs, Seepage.
Identifiers: Blasting, \*Arrow Dam (Canada),

Arrow Dam stores Columbia River water in southeast British Columbia. A sand and gravel cofferdam protected the concrete control structures during construction. The central impervious membrane of the cofferdam was a concrete cutoff wall keyed into bedrock and formed by the slurry trench process. The upper core was built of compacted impervious till. The cofferdam withstood a max-imum hydraulic head of 115 ft and remained in place for almost 2 yr. Maximum seepage was less than 600 (Imp) gal/ min. The cutoff wall cost about \$21/sq ft and avoided the uncertainties associated with a pumping-type dewatering scheme.
Weathered rock to 15 ft thick overlying bedrock was grouted through pipes installed in the cutoff wall. Blasting in holes on 3-ft centers removed the cutoff wall. The holes were charged with 16-in. cartridges, placed 4 feet apart, to provide a powder factor of 1.5 lb/cu yd of concrete. (USBR) W69-02572

### COMPARISON OF THE SOIL CORROSION RE-SISTANCE OF DUCTILE IRON PIPE AND GRAY CAST IRON PIPE,

American Cast Iron Pipe Co., Birmingham, Ala. E. C. Sears.

Mater Prot, Vol 7, No 10, pp 33-36, Oct 1968. 4 p, 1 fig. 4 tab, 11 ref.

Descriptors: Experimental data, \*Cast iron, \*Pipes, Pipelines, Field tests, \*Water pipes, Metallurgy, Iron, Thickness, Pitting, Soil surveys, \*Corrosion, Corrosion control, Polyethylenes, Protective coatings, Durability, Specifications.
Identifiers: \*Underground corrosion, Soil corrosiveness, \*Gray cast iron, \*Ductile cast iron, \*Cast iron pipe, Corrosion resistance.

Soil corrosion resistance of ductile iron pipe is compared with gray cast iron pipe in a discussion of metallurgical characteristics, chemical composition, and soil corrosion field tests. The durability of tion, and soil corrosion field tests. The durability of cast iron, attributed to a graphitic layer formed during initial attack, is reviewed for better understanding of ductile pipe soil corrosion resistance. Soil corrosion tests conducted by the Cast Iron Research Ass, Stanton-Stavely Ltd of England, and National Bureau of Standards are discussed; and National Bureau of Standards are discussed; analyses of National Bureau of Standards test results by several organizations are reviewed. Ductile iron and gray cast iron pipe are similar in several factors relating to comparative performance in pipeline service. The major difference is wall thickness; for comparable service conditions, ductile iron pipe generally can have less thickness because of its higher strength. With equal pitting, the thinner ductile iron pipe retains greater strength than gray iron pipe. Ductile iron pipe, with thickness specified in USA Standards, may be used in most soils with assurance of durability. In corrosive soils, polyethylene sleeving provides effective and economical protection. (USBR) W69-02578

## APPLICATION OF THE DYNAMIC THEORY OF SEISMIC STABILITY TO CALCULATION OF ARCH DAMS FOR LATERAL SEISMS,

An. A. Losaberidze.

Hydrotech Constr, No 7, pp 629-634, July 1967. 6 p. 10 fig. 5 ref.

Descriptors: \*Arch dams, Dam design, Concrete dams, Horizontal loads, Dam foundations, \*Seismic design, Seismic waves, Structural analysis, Earthquakes, \*Lateral forces, Elastic deformation, Cantilevers, Seismic studies, Deflection, Deformation, Elasticity, Load distribution, Stress analysis, Model tests, Earthquake engineering, Foreign design practices. Identifiers: Shakers, Seismic stability, USSR,

Earthquake loads.

During an earthquake, horizontal waves in the earth's surface can approach a dam foundation from any direction relative to the longitudinal axis. Experimental studies of arch dam models showed that the most dangerous condition for stress in a dam arises from lateral seismic waves. Elastic vibratory motion of the body of a symmetrical arch dam in the vertical plane of symmetry, under the lateral action of seismic waves, can be approximated as 2 basic constituents: a skew-symmetrical bending oscillation as 2 half-waves, which satisfies the first skew-symmetrical form of the free-bending oscillation; and the skew-symmetrical oscillation of tension-compression for 2 zones, satisfying the first form of the free skew-symmetrical oscillation of tension-compression. To examine the first component of motion, the arch dam ideally is divided into a series of mutually acting horizontal arches and vertical cantilevers. The following assumptions are made regarding the second component of motion: basic components of movement are tangent to the axis of the arch; inertial forces will be developed in the base in a tangential direction, distributed as concentrated forces; the arches will undergo tension-compression deformation and the cantilevers, displacement-deformation. (USBR) W69-02585

## LARGE EARTHQUAKE FORCES ON GRAVITY

Imperial Coll. of Science and Technology, London

(England). N. N. Ambraseys, and S. K. Sarma. Nature, Vol 219, No 5161, pp 1354-1356, Sept 1968. 3 p, 4 fig, 1 tab, 6 ref.

Descriptors: Concrete dams, \*Gravity dams, \*Earthquakes, Earthquake engineering, Hydraulic structures, Seismic design, \*Accelerographs, Measuring instruments, Cracks, Motion, Recording systems, Seismic studies, Dams, Foreign research. Identifiers: India, Koyna Dam (India), Seismic stationary of the s

On December 10, 1967, an earthquake of magnitude 6.5 shook western India. Before the nitude 6.5 shook western india. Before the earthquake, a strong-motion accelerograph had been installed in a gallery in the body of Koyna Dam near the right abutment. At this point, the structure is 31 m high and the instrument was located about 12 m above foundation level. The instrument functioned a property of the structure strument functioned properly during the earthquake, but a 3-component record produced was very faint and sometimes difficult to read. Interpretation of the recorded data is discussed. The transverse component showed a maximum acceleration of nearly 50% g; the average longitudinal acceleration exceeded 55% g. Records show that acceleration after 4 sec reached a peak value and returned to zero in about 50 msec. Thus, duration of these large inertia forces on the structure was very short, and damage to the dam was very slight. Recorded accelerations in the dam are assumed to be the same as ground accelerations in the dam are assumed to be the same as ground accelerations because of the stiffness of the dam. The Koyna records show that severe loads (greater than 0.5 g) can occur on engineering structures because of earthquakes. The fact that the dam did not fail, although it was not designed to resist earthquakes, questions the validity of current seismic design methods. (USBR) W69-02596

#### GOKCEKAYA ARCH DAM, COMPARISON OF THREE METHODS OF ANALYSIS,

N. P. Triano, and G. A. Kanakaris. Amer Soc Civ Eng Conf, Pittsburgh, Pa, Aug 1968. 19 p, 5 fig, 6 ref.

Descriptors: \*Arch dams, Concrete dams, Structural analysis, \*Dam design, Dam foundations, Grout curtains, Foreign design practices, Model tests, Construction joints, Seismic design, Elasticity modulus, Geology, Thrust bearings, Monoliths, Design criteria, Cantilevers, Structural models, Safety, Trial-load method.

Identifiers: In situ tests, Allowable stress, Earthquake loads, Turkey, Gokcekaya Dam (Tur-

Gokcekaya Dam is a 521-ft-high, thin, double-curvature arch dam located in Turkey. The dam axis spans 2 prominent projections along a gorge. Bedrock at the site is a hard, dark gray, massive, coarse-grained sericite-chlorite schist. In-place bearing tests determined the rock modulus of the foundation. A grout curtain varying from 30 m at the upstream face to 70 m at the downstream face was installed. Thrust blocks are provided at each abutment of the arch to distribute compression and shear forces imposed by arch loads. Allowable stresses for the concrete and foundations are 1000psi compression and 150-psi tension for the normal reservoir level and dead load condition. These are increased 33-1/3% for temperature and earthquake loading conditions. Magnitude of the structure dictated that more than one method of investigation should be made for controlling the loading condi-tion. Model tests and analytical methods (multiple cantilever) were used to analyze the design. Final design was verified by the trial-load method, based on radial, tangential, and twist adjustments. (USBR) W69-02600

## AN INTRODUCTION TO THE INSURANCE OF

CONSTRUCTION PROJECTS, Clarkson Arbon (Overseas) Ltd., London (En-

gland). E. M. de Saventhem, and C. A. Muller. London, Clarkson Arbon (Overseas) Ltd, Aug 1968. 19 p.

Descriptors: Construction, Economies, Contracting, Construction costs, \*Insurance costs, Damages, Personnel, \*Liabilities, \*Claims, Accidents, Foreign countries, Benefits, Losses, \*Contract administration, Risks, \*Insurance, \*Con-

Identifiers: Injuries, Great Britain.

Construction projects are becoming technically more ambitious and more costly. Owners must seek maximum protection against outside risks due to professional or financial inadequacy or failure of any firm selected to take part in completing the project, and to hazards potentially inherent in nature or location of the project, including accidental loss, damage, or injury. A fourfold system of safeguards devised by consulting engineers for the owner's protection includes: (1) bid and performance bonds, (2) retention monies, (3) Care of Works and Damage to Persons and Property clauses, and (4) Contractors' All Risks and Third Party Liability insurances. These safeguards and their practical applications mainly relating to performance bonds and insurance, are considered. Owners would derive considerable benefit from arranging (prior to issuance of invitations) an overall insurance to cover loss or damage to the works and property (their own or contractors') at the site, and liability for loss, damage, or injury to third parties (including property and personnel of owners or any contractor). (USBR)
W69-02603

#### **Group 8B—Hydraulics**

#### 8B. Hydraulics

SURVEY OF PROGRAMS FOR WATER-SUR-FACE PROFILES.

Corps of Engineers, Sacramento, Calif.

Bill S. Eichert.

Amer Soc Civ Hydraul Div Conf, Massachusetts Inst Tech, Cambridge, Aug 1968. 33 p, 5 fig, 2 tab,

Descriptors: \*Water-surface profiles, \*Computer programming, Roughness coefficients, Hydraulics, Subcritical flow, Backwater, Bibliographies, Bridge piers, Supercritical flow, Cross sections, Technical societies, \*Computer programs, Open channel

Identifiers: FORTRAN.

Computer programs for determining water-surface profiles have been developed by Government agencies and private organizations. However, no single program has all of the desirable capabilities. Developing a satisfactory all-purpose computer program to meet the needs of many organizations will require much work. To accomplish this task and reduce duplication of effort, the writer suggests that ASCE or other professional organizations take the lead in organizing a committee to coordinate these efforts. This committee should collect, review, and report its findings on water-surface profile computer programs to the civil engineering profession through technical journals. Ultimately, the committee should direct or coordinate the development, testing, instruction, application, and documentation of such a computer program. The various parameters affecting the water-surface profile, to be incorporated in the different computer programs, are discussed. (USBR) W69-02556

### A CONTRIBUTION TO OPEN CHANNEL SURGE SIMULATION BY DIGITAL COM-PUTER.

Georgia Inst. of Tech., Atlanta; and Harza En-

gineering Co., Chicago, Ill. C. S. Martin, and F. G. DeFazio.

Annu Conf Hydraul Div, Amer Soc Civ Eng, Massachusetts Inst Tech, Cambridge, Aug 1968. 49 p, 25 fig, 1 tab, 12 ref.

Descriptors: \*Surges, Open channels, \*Open channel flow, Computer programming, \*Simulation, Waves (Water), Unsteady flow, \*Bore (Wave), Finite differences, Flow, Hydraulics, Water surface profiles, Flood hydrographs, Hydrographs, Tailrace, Trapezoidal channels, Rectangular conduits.

Identifiers: Bifurcations, Stoker method.

Equations of motion for unsteady, gradually-varied flow in open channels are expressed in a finite-difference form suitable for programming on a digital computer. The staggered-net scheme introduced by Stoker is expanded to apply to a system of N interconnected channels, with each of their ends subject to one of the following boundary conditions: discharge hydrograph, stage hydrograph, stagedischarge relationship, and dead end or junction of channels. The theory and computer program are tested and compared with existing experimental results corresponding to the following situations: (1) flood hydrograph in circular channel; (2) power-load rejection in headrace of trapezoidal canal; (3) power-load acceptance in tailrace of rectangular model channel; and (4) tidal (stage hydrograph) in rectangular model estuary. Because of good correlation between simulated and experimental results in all 4 instances, and the ease of coding various problems, the staggered-net scheme of Stoker is recommended. (USBR) W69-02557

## UNSTEADY FLOW SIMULATION IN RIVERS AND RESERVOIRS APPLICATIONS AND LIMITATIONS,

Tennessee Valley Authority, Norris.

Jack M. Garrison, Jean-Pierre Granju, and James

Hydraul Div Spec Conf, Amer Soc Civ Eng, Massachusetts Inst Tech, Cambridge, Aug 1968. 75 p, 30 fig, 2 tab, 13 ref, 2 append.

Descriptors: \*Unsteady flow, \*Simulation, \*Rivers, \*Reservoirs, \*Open channel flow, Transients, Computer programming, Waves (Water), Digital computers, Translatory waves, Discharges, Reservoir operation, Water surface profiles, Hydrographs, Hydraulics, Mathematical models, Waves, low, Flood hydrographs. Identifiers: Stoker method.

A computer program for solving basic equations of unsteady flow in reservoirs and rivers is being used by TVA to solve various open-channel flow problems. The program has been used to: (1) investigate flow condition problems at the cooling water facilities of a nuclear powerplant, resulting from hydroplant operations at both ends of the reservoir, (2) determine velocity and stage variations in a narrow winding river below an existing hydroplant used for peaking operations, (3) determine timespace variations in discharge, velocity, and water surface elevation in a reservoir subjected to operations of a proposed pumped-storage plant, (4) determine unsteady flow conditions in a system of 2 large reservoirs connected by a 1.2-mi-long navigable canal, and (5) investigate reservoir acceleration effects on the passage of a flood wave through a proposed reservoir. Computer results and field measurements were in good agreement in the 3 cases where field data were taken, including reverse flows in 2 reservoirs and in the canal and locking operations in one of the river reaches. Results of these and a related transient study are described, explanations are given for several poorly understood phenomena occurring frequently in unsteady flows, and the mathematical model is described and evaluated. (USBR) W69-02558

## SEDIMENT DISTRIBUTION IN TURBULENT

Universidad Central de Venezuela, Caracas. For primary bibliographic entry see Field 02J. For abstract, see . W69-02564

#### ANALYSIS OF INTEGRATING-FLOAT FLOW MEASUREMENT.

Missouri Univ., Columbia; and Tennessee Valley Authority, Norris. Henry Liu, and Larry D. Martin.

Proc Amer Soc Civ Eng, J Hydraul Div, Vol 94, No HY5, pp 1245-1260, Sept 1968. 16 p, 4 fig, 2 tab, 26 ref, 3 append.

Descriptors: \*Flow measurement, \*Water measurement, Streamflow, Flow, \*Discharge measurement, Flowmeters, Fluid flow, Turbulence, Hydraulics, Analysis, Accelerating, Spheres, Floats, Bibliographies.
Identifiers: \*Integrating-float method.

The classical technique of streamflow measurement by the integrating-float method is reex-amined. The effect of float acceleration on discharges measured by the technique is analyzed, using existing data for the acceleration of spheres in fluids in the gravitational field. Other sources of error, such as those due to nonuniformity of flow, turbulence, secondary currents, and fluid density stratification are described. After sufficient development, this technique may be particularly suitable for streamflow measurement at low veloci-ties. Other potential advantages are indicated.

CALCULATION OF STRESS VARIATION IN PRESSURE PENSTOCKS AT A HYDROELECTRIC STATION, UTILIZING AN EVTSM, G. I. Nubel'man.

Hydrotech Constr, No 7, pp 635-640, July 1967. 65 p. 6 fig. 3 ref.

Descriptors: \*Penstocks, \*Stress, Transient stress, High pressures, Digital computers, Mathematical High pressures, Digital computers, Mathematical analysis, Water hammer, Discharges, Hydroelectric powerplants, \*Optimum design, Mechanical engineering, Calculations, Safety, Speed regulators, Unsteady flow, Foreign research, Pressure vessels, \*Stress analysis, Governors. Identifiers: USSR, Accuracy, Bifurcations.

For the most economic installation at high-head hydroelectric powerplants, designers must precis ly calculate stress variation in pressure penstocks resulting from regulation of units, unsteady flow, and from the turbines. Existing theoretical assumptions permit determination of these stress variations, although the process is time-consuming and inaccurate because of averaging methods used. The author proposes an electronic digital computer method of calculating stress variations in penstocks by creating mathematical models of the penstock and turbines. Various phases of the calculating procedure and results are presented. The author concludes that electronic digital computers may be used effectively for calculating pressure fluctuations in penstocks of hydroelectric powerplants or stable control systems, permitting automatic selection of optimal variants of powerplant equipment parameters. An electronic computer is needed to develop the information tables and monograms of water hammer in branched penstocks to be used in initial design stages. (USBR) W69-02584

#### PLAN OF THE CHANNEL OF FREELY MEAN-DERING BENDS,

F. S. Tyrin. Int Geol Rev, Vol 10, No 9, pp 1058-1062, Sept 1968. 5 p, 3 fig, 1 tab, 8 ref.

\*Meanders, \*Rivers, Channels, \*Streams, Bends, Hydrology, Streambeds, Mathematical studies, River training, \*Stream meandering, Foreign design practices.

Identifiers: Radius of curvature, USSR, \*Curva-

Reshaping the plan of a river channel is of great importance because of the ever-increasing construc-tion of hydraulic and other engineering structures tion of hydrauic and other engineering structures on the flood plains of rivers. The first problem is determining the curve of the plan of freely meandering bends, this being the most prevailing channel process in rivers of the plains. The radius of curvature of a streambed, at any given point, may be calculated from the median line of the streambed, obtained by the sequence of certain justifiable approximations, so that planar reconstitutions of freely meandering rivers may be ascertained without recourse to measurements on the ground. (USBR) W69-02601

## DESIGN OF OPTIMAL HYDRAULIC NET-WORKS.

WORKS, Boeing Co., Renton, Wash. Shmuel L. S. Jacoby. Amer Soc Civil Eng Proc, Vol 94, No HY3, pp 641-661, May 1968. 21 p, 4 fig, 3 tab, 8 ref, 2 append.

Descriptors: Digital computers, Discharge coeffi-Descriptors: Digital computers, Discharge coefficients, \*Economic efficiency, Efficiencies, Electric power costs, \*Hydraulic design, Hydraulic properties, Hydraulic systems, \*Mathematical models, \*Network design, Networks, \*Optimization, Pumps, Water distribution (Applied).

Identifiers: Boundary conditions, Hardy Cross procedure, Nonlinear programming.

The design of optimal hydraulic networks was formulated as a mathematical problem using the method of gradient-random-experience directions. The network consisted of elements, nodes, and independent loops. Constrained by the continuity of flow at the nodes, the fluid properties, and friction loss relationships, cost functions were derived which depended on the pipe diameters and lengths, pump head, flow and efficiency, power cost, time period, and constants. The problem was formulated with boundary flow conditions (diameters and hydraulic-head as decision variables) or boundary head conditions (discharge and diameters as decision variables), based on the Hardy Cross procedure. It was treated as a continuous nonlinear optimization problem. The integer requirements of pipe and pump sized nearest the optimal solution were checked for feasibility. Numerical examples given seemed to terminate at various local minima, suggesting that precautionary starting procedures should be taken. Effects of changes in the network mode of operation or boundary conditions could be studied using the proposed formulation. (Gysi-Cornell) W69-02621

MEASURING AND SAMPLING RUNOFF FROM FLAT LANDS.

Agricultural Research Service, Washington, D. C.; and Louisiana State Univ., Baton Rouge. Agricultural Experiment Station.

G. H. Willis, and J. M. Laflen. Water Resources Res, Vol 4, No 6, pp 1347-1349, December 1968. 3 p, 1 fig.

Descriptors: \*Instrumentation, \*Runoff, \*Overland flow, \*Gaging stations, \*Flumes, Sampling, Laboratory tests, On-site tests, Nitrates, Endrin, Silts, Clays.

Identifiers: Geib multislot divisor, Parshall flumes.

A system of measuring and sampling runoff was devised for use on nearly level lands by joining a Parshall flume and a Geib multislot divisor in series. The collected sample is pumped from a sump into above-ground storage tanks that have a capacity of 12 inches of runoff. The system remains functional even with drainage ditches at near capacity. Samples collected by the system were representative of the runoff water entering the system with regard to their silt and clay content and the concentration of added nitrate and endrin during the various flow rates and sediment concentrations tested. W69-02682

#### 8C. Hydraulic Machinery

FAULT SURGE VERSUS SWITCHING SURGE A STUDY OF TRANSIENT OVERVOLTAGES CAUSED BY LINE-TO-GROUND FAULTS, Bonneville Power Administration, Portland, Oreg. Edward W. Kimbark, and Alvin C. Legate. Inst Elec Electron Eng Trans Power App Syst, Vol PAS-87, No 9, pp 1762-1769, Sept 1968. 8 p, 15 fig, 5 ref, append.

Descriptors: \*Faults (Electrical), Circuit breakers, Transients, Extra high voltage, Transmission lines, Electrical impedance, \*Surges, Energy, Economies, Investigations, Capacitors, Resistors, \*Electric insulation, Oscillographs, Electric potential,

Theory.
Identifiers: \*Overvoltage, \*Switching surges,
\*Switching, \*Flashover, Shunt reactors, Network

Transient overvoltages caused by single line-to-ground short circuits on 3-phase transmission lines are studied. A method of decreasing such overvoltages is presented. Results are from tests made on the Bonneville Power Administration's transient the Bonneville Power Administration's transient network analyzer on a simulated 180-mi, 500-ky, 60-cycle, 3-phase unloaded line. When improvements in extra-high-voltage power circuit breakers now being studied are adopted, overvoltages caused by energization or reenergization of lines can be made so low that the limiting factor determining the amount the line insulation may be adverted the overvoltage produced. reduced might become the overvoltage produced by single line-to-ground faults. On lines insulated

for levels below twice the normal line-to-ground crest voltage, such faults could develop into double line-to-ground faults, which would be particularly objectionable if single-pole switching were to be employed. (USBR) W69-02561

#### EXPERIENCE IN OPERATION OF THE GOR'-KII HYDROELECTRIC STATION,

Hydrotech Constr, No 9, pp 805-814, Sept 1967. 10 p, 7 fig, 8 tab, 2 ref.

Descriptors: \*Hydroelectric powerplants, Earth dams, Spillways, Marl, Spillway gates, Foundations, Erosion, \*Operations, Seepage, Navigation, Hydraulic turbines, Electric generators, Handling equipment, Settlement, Operation and maintenance, Foreign projects, Slope protection, Floods, Clays, Sands, Foreign construction, Hydraulic design

Identifiers: USSR, \*Gor'kii Powerplant (USSR), Power grids, Volga River (USSR).

The Gor'kii Hydroelectric complex, consisting of a 13,332-m-long earth dam, a spillway section, navigation structures, an 8-unit powerplant, and an outdoor switchyard, is the fourth in a chain of installations along the Volga. The complex is situated stallations along the Volga. The complex is situated in an area underlain with sandy-clay deposits on top of a clayey-marl stratum. Seepage problems through the dam and powerplant are discussed; settlement of concrete structures has been recorded. Data are given on the powerplant structure, tur-bines, generators, handling equipment, and service facilities. The gravity-type spillway is 291 m long with 12 openings, 10 having 2-section gates and 2 having dual gates for wasting trash and floating debris. Operations are discussed, with particular emphasis on crosion in areas downstream of the powerplant and spillway. (USBR) W69-02579

#### AHEAD FOR **TUNNELING** WHAT'S MACHINES.

Ingersoll-Rand Co., Princeton, N. J. George Hill.

Proc Amer Soc Civ Eng, J Constr Div, Vol 94, No CO2, pp 211-231, Oct 1968. 21 p, 11 fig, 4 tab, 9 ref, 5 append.

Descriptors: \*Tunneling, \*Tunneling machines, Tunnels, Water tunnels (Conveyance), Evaluation, \*Boring machines, Excavation, Drilling, Costs, Construction, Economics, Safety, Blasts, Vehicular tunnels, Mining, Costs comparisons, Rock excavation, History, Construction costs. Identifiers: Blasting.

Tunnel construction data from 1955-1965 are reviewed to establish particular characteristics of the past-tunneling market. These characteristics include: (1) total footage of tunnel construction completed each year; (2) a breakdown of these tunnels according to use (water transportation, vehicle tunnels, railroad and subway tunnels, and mining tunnels); and (3) a profile of the 1955-1965 tunneling according to unlined-tunnel diameter and tunnel length. These data provided a history of tunneling activity and growth rates, used in conjunction with expert opinions and announced fu-ture tunneling expectations, to develop a forecast of 3000 mi of worldwide-tunneling activity from 1966-1976. To estimate the impact of tunneling machines on the total market, a detailed cost analysis is outlined for drill and blast vs mechanical boring. The economic comparison showed tunneling machines to be an effective economic alternative in a significant portion of future tunneling. Estimates indicate that tunneling machines will complete 1000 mi of the 3000 mi forecast between 1966 and 1976. Reasons for this estimate are: (1) lowest total-tunnel costs, (2) development of tunneling machines in the next 10 yr, (3) safety, (4) standardization of tunnel sizes, and (5) faster advance rates. (USBR)

THE INFLUENCE OF UNCERTAINTY IN STREAMFLOW ON FIRM POWER COMMITMENT IN HYDROELECTRIC POWER SYSTEMS,

Stanford Univ., Calif. For primary bibliographic entry see Field 06A For abstract, see . W69-02616

# SOME COMMENTS ON REGIONALIZATION IN HYDROLOGIC STUDIES, Geological Survey, Arlington, Va. N. C. Matalas, and E. J. Gilroy.

Water Resources Res, Vol 4, No 6, pp 1361-1369,

Descriptors: \*Markov processes, \*Statistical methods, \*Streamflow forecasting, Synthetic hydrology.

Identifiers: Regionalization.

Dec 1968, 7 ref.

In synthetic hydrology, regionalization of the estimates of the historical parameters at a number of gaged sites in a river basin, via regression analysis, with physiographic and meteorologic characteristics of the basin is proposed as a means of facilitating the reduction of operational bias, the difference between historical parameters and their respective population values. In effect, regionalization attempts to extend the lengths of the historical sequences by means of the spatial variation inherent among the historical sequences. The regression relation provides a means of estimating the parameters at ungaged sites, thus permitting synthetic sequences to be generated at these sites. At the jth site, a choice must be made between y sub i, a statistical characteristic of the observed flows, and bar y sub i, a regionalized estimate of the characteristic, for use in the model for generating synthetic flows at the jth site. The regional estimate is obtained from a regression of y on a set of basin characteristics. If regionalized V sub jj/ V sub jj is smaller than (2 - rho prime), then regionalized sub i instead of y sub i is used in the generating model, where regionalized V sub jj and V sub jj are the variances of regionalized y sub i, respectively, and rho prime is a measure of the interstation correlations. This criterion is shown to be independent of the jth basin characteristics. The criterion is a function of the jth basin characteristics if the data at the jth site are not used in developing the regression relation. For an ungaged site, regionalized y sub i may be obtained with variance that depends upon the basin characteristics at the jth ungaged site. (Knapp-USGS) W69-02667

#### **8D. Soil Mechanics**

#### SAND COMPACTION WITH VIBRATORY ROLLERS.

Massachusetts Inst. of Tech., Cambridge; and D'Appolonia (E.), Consulting Engineers, Inc., Pitt-

D. J. D'Appolonia, R. V. Whitman, and E.

D'Appolonia.

Amer Soc Civ Eng Spec Conf, Cambridge, Mass, Aug 1968. 46 p, 19 fig, 2 tab, 20 ref, append.

Descriptors: \*Compaction, \*Compaction equipment, Bibliographies, \*Soil compaction, Compac tion tests, Vibrators (Mechanical), \*Rollers, Relative density, \*Sands, \*Dune sands, Granular materials, Rolling, Density, Soil dynamics, Lifts (Construction), Soil mechanics, Damping. Identifiers: \*Vibratory compaction, Vibration tests, At rest pressure.

Smooth-drum vibratory rollers were used to sur-Smooth-drum vioratory rollers were used to sufface-compact a poorly graded dune sand. The compactive effort was ineffective at depths greater than 4-5 ft. Compacted density at any depth increases with the number of roller coverages but after about 5 passes, a large increase in the number of passes is required to achieve a significant increase in density of the control of the significant increase in density of the control of the significant increase in density of the significant increase. ty. When sandfill is placed in lifts, the lift height should not be significantly less than the depth at which maximum compaction occurs for a single lift

#### Group 8D - Soil Mechanics

or much of the compactive effort will be lost through repeated overvibration of near-surface layers. Compacted density, ground acceleration, and dynamic stress increased with operating frequency. The roller-soil system appears to be highly damped for operating frequencies less than 30 cps, indicating that a clearly defined resonant frequency does not exist. Operating frequency should be as large as resonant frequency to obtain the most efficient use of the vibratory roller. Except at the surface, the most efficient compaction is achieved in the zone where minimum soil stress decreases to zero. Measurements of horizontal stress in vibratory compacted sandfill indicate that lateral stresses are significantly greater than the atrest earth pressure. (USBR)

# EXPLOSIVELY CONSTRUCTED DAM OF THE BAIPAZINSK HYDROCOMPLEX ON THE VAKHSH RIVER,

R. S. Ariel, O. A. Leont'ev, and A. L.

Transl from Gidrotekh i Melior, No 7, pp 1-8, July 1968. Bur Reclam Transl 789, Oct 1968. 22 p, 9 fig, 4 photo.

Descriptors: \*Foreign construction, Foreign projects, \*Explosions, \*Rockfill dams, Diversion dams, Charges (Explosives), Tunnels, Seepage, Irrigation systems, \*River closures, Dam design, Irrigation canals, Dam construction, Explosives, Impervious blankets, Fines, Seepage losses, Construc-tion.

Identifiers: USSR, Baipazinsk Dam (USSR), Vakhsh River (USSR), \*Slide dams, \*Explosive construction, Nurek Powerplant (USSR).

On March 29, 1968, a rockfill diversion dam, having a volume near 1.55 million cu m, was constructed by an explosion in the Vakhsh River Canyon at Baipazinsk, 30 km below Nurek Dam in the Tadzhik SSR. The explosive charge (1800 t) closed the change in the transfer of the charge (1800 t) closed the change in the transfer of the charge (1800 t). closed the channel without damaging the previously constructed spillway or tunnel and water was then diverted to the semi-arid lavinsk-Obikiiksk valleys. The dam is one feature of a project to irrigate 40,000 ha of fertile land suitable for raising rigate 40,000 ha of fertile land suitable for raising fine-fiber cotton. The project includes Nurek Dam to store water and generate power, a canal system (from 15 to 30 cu m/sec), pumping plants, 23 inverted siphons, 28 aqueducts, 7 high fill embankments, and more than 600 large hydraulic structures, all constructed on strongly slumping loessial soils. Constructing the dam explosively reduced construction time and costs, and both could have been excessive in the narrow canyon. To reduce the seismic effect. 3 groups of charges were the seismic effect, 3 groups of charges were detonated successively, then 30,000 cu m of fines were exploded to form an impervious blanket in the channel. When the head reached 24 m on March gates were opened to release water downstream. Water began flowing through the tunnel by the middle of May. (USBR) 30, seepage was 4 cu m/sec, and 2 of the 4 spillway

#### 8E. Rock Mechanics **AND Geology**

APPLICATION OF PRINCIPLES OF ROCK MECHANICS TO BLASTING AND SUPPORT OF THE NORAD EXCAVATIONS,

Barodynamics, Inc., Georgetown, Colo.; and Corps of Engineers, Omaha, Nebr.
For primary bibliographic entry see Field 08H. For primary biblio For abstract, see . W69-02563

MEASURES OF THE DEGREE OF CHEMICAL WEATHERING OF ROCKS, Commonwealth Scientific and Industrial Research

Commonweath Scientific and Industrial Research Organization, Canberra (Australia). Bryan P. Ruxton. J Geol, Vol 76, No 5, pp 518-527, Sept 1968. 10 p,

Descriptors: \*Rocks, \*Weathering, Chemical analysis, Tropical regions, Humid areas, Rock proper-ties, Bibliographies, Leaching, Lava, Minerals, Chemical properties, Geologic investigations, Decomposition, Engineering geology, Petrographic investigations, Chemical stability, Igneous rocks,

Silica, Kaolin, Geology.
Identifiers: \*Rock weathering, Volcanic rocks,
Aluminum oxides, Rock alteration, Pedology.

The degree of rock weathering in humid areas may be easily measured using silica-to-alumina mole ratios. The reliability of this index depends upon ratios. The reliability of this index depends upon uniformity of the bedrock, consistency of alumina content during weathering, correlation between silica and total element losses, and the difference between silica-to-alumina mole ratios of fresh and thoroughly weathered rock. Total silicate analyses of fresh and derivative weathered rock from 64 nonquartz-bearing volcanic rocks in northeast Papua, and 48 igneous and metamorphic rocks from other humid areas, showed good correlation between silica and total element losses, and between the silica-to-alumina mole ratio and total element loss. The silica-to-alumina mole ratio also correlates well with the more complex absolute and relative weathering indices calculated from total silicate analyses. The silica-to-alumina mole ratio silicate analyses. The sinca-to-autimal note rate will be a useful guide to physical, chemical, and engineering properties of rocks; however, the index is less suitable for strongly seasonal savanna or more arid areas. (USBR) W69-02565

STRENGTH OF ROCK-LIKE MATERIALS,

Swedish Detonic Research Foundation, Stockholm.

N. Lundborg. Int J Rock Mech Mining Sci, Vol 5, No 5, pp 427-454, Sept 1968. 28 p, 38 fig, 1 tab, 76 ref, 2 ap-

Descriptors: \*Rock mechanics, Rocks, \*Brittle failures, \*Shear tests, Bibliographies, Pore pressures, Materials testing, Triaxial compression, Strength of materials, Rock properties, Test procedures, Test specimens, Underground structures, \*Triaxial shear, Triaxial stress, Unconfined compression, Triaxial tension, Splitting tensile

Identifiers: Coulomb-Navier model, Griffith theory, Foreign testing, Coulomb-Mohr criterion, Brittle fracture theory, Sweden.

The strength of brittle materials, such as rock, is greatly increased by external hydrostatic pressure. In underground structures and deep mines, the pressure is superposed with 1 or 2 principal stresses, and strength increases with depth. Rock strength in underground rooms also depends on the volume of excavation and internal pore pressures, volume of excavation and internal pore pressures, implying that strength determinations are not simple. The strength of rock under triaxial stress conditions and the most common theories of brittle fracture are reviewed. Some methods of triaxial strength determination are described and results compared. The strength dependence of lateral pressure, pore pressure, and size of test specimen is discussed. Several standard test procedures are suggested for uniaxial, triaxial, and shear testing. The confined double shear test has been used for measuring the strength of Swedish rocks and ores. This is a simple arrangement, permitting shear tests at higher normal pressures, and has advantages in predetermining the rupture surface and increasing normal pressures to arbitrary values. (USBR) W69-02573

#### DISTRIBUTION OF FORCES BETWEEN ROCK AND THE LINING OF A PRESSURE TUNNEL.

G. G. Khachikyan. Hydrotech Constr, No 9, pp 801-804, Sept 1967. 4

Descriptors: \*Pressure tunnels, \*Tunnel linings, Stress distribution, \*Hydrostatic pressures, Stress relieving, Rocks, Rock mechanics, Foreign design practices, \*Tunnel design, Pressure conduits, Pen-

stocks, Cracks, \*Pressure distribution, Fractures, Grouting, Radial stress. Identifiers: Concrete linings, USSR, Joints (Geolo-

A rock mass working conjointly with a tunnel lining under internal water pressure relieves forces in the lining. The intensity of relief largely depends on the strength and elastic properties of the rock. Pressure tunnel tests at the Amsteg hydropower develop-ment showed that sericite schists absorb 20-40% of the total internal pressure; similar tests at Dzora hydropower station showed that dacites take up 30-50% of the load. Stronger rock would ease the static working conditions at tunnel linings even more. In driving a tunnel, cracks are formed in the rock by stress redistribution and drilling and blasting operations. Radial displacements of rock in the disturbed region are greater than in the monolithic mass. The boundary of the jointed zone also depends on the pressure transmitted from the lining, which causes radial cracking in rock of low tensile strength. A mathematical method determines the relief factor for a circular pressure tunnel with a monolithic concrete lining. The relief factor depends on the elastic properties of rock and concrete, lining thickness, and the zone of fractured rock close to the excavation. Loading relief can be increased by reducing concrete lining, which is impracticable, or by grouting fractured rock. (USBR) W69-02575

### THE THREE MAJOR PROBLEMS IN ROCK SLOPE STABILITY IN CANADA, Golder, Brawner and Associates, Ltd., Vancouver

(British Columbia).

C. O. Brawner.

Prepr No 68-A-333, Soc Mining Eng AIME, Minneapolis, Minn, Sept 1968. 33 p, 13 fig, 17 ref.

Descriptors: Rock mechanics, Rock excavation, \*Mining, Mines, Beds (Geology), \*Slopes, Stability analysis, Blasts, Groundwater, Joints, Shear strength, Shear stress, Neutral stress, Fractures, Foreign design practices, Faults (Geology), Drilling, Economics, Safety, Engineering geology, Joints (Geology), \*Slope stability, Bibliographies. Identifiers: Blasting, \*Open pit mining, Geologic defects, Canada, \*Rock slope stability, Rock

As excavation depths in open pit mining increase and ore grades decrease, safety and economy in pit slope stability become increasingly important. Three important factors influencing slope stability are rock structure, ground water, and drilling and blasting programs. Examples of the influence of these factors on slope stability are given. Geologic, hydrologic, topographic, and climatic conditions, and mining programs differ at each mine. Each location must be evaluated individually, with the selection of the final slope design based upon actual site conditions. Stability of rock slopes in jointed, bedded, or faulted rock depends primarily on the orientation of mechanical defects. Ground water influences stability by creating seepage preson the orientation of mechanical defects. Ground water influences stability by creating seepage pressures resulting from friction flow losses; forces resisting sliding are reduced by the neutral pressure of cleft water. Shear stresses in the rock are increased by dynamic acceleration forces caused by blasting. Blasting also causes additional joints and fractures which reduce stability. (USBR) W69-02593

#### 8F. Concrete

**FATIGUE** OF WATER-SATURATED CONCRETE, T. S. Karanfilov. Hydrotech Constr, No 9, pp 798-800, Sept 1967. 3

Descriptors: Concrete, Concrete structures, Concrete technoloby, Moist condition, \*Concrete testing, \*Saturation, \*Fatigue (Mechanics), testing, \*Saturation, \*Fatigue (Mechanics), Cracks, Absorption, Internal friction, Materials

#### Research Facilities — Group 9C

testing, Wet condition, Loads, Strength of materials, Hydraulic structures.

Identifiers: Microcracks, \*Repeated loading, Foreign testing, \*Cyclic loads, USSR, Fatigue tests, Concrete properties.

Many reinforced-concrete hydraulic structures are exposed to cycles of partial or complete water saturation. Data are lacking on the fatigue of concrete exposed to cyclic saturation. Laboratory tests show how the fatigue limit of water-saturated concrete varies with load cycles. The fatigue strength of saturated concrete is much lower than dry concrete, and appears to be independent of the type of stress for water-saturated and dry concretes. At this stage of investigation, absorption effects, cleaving effects of thin water films, softening of concrete, and leaching appear to be factors in the decreased fatigue limit for water-saturated concrete. Repeated loadings spread existing cracks and form new microcracks. Water entering the existing and incipient cracks spreads as a monomolecular film and increases stresses in the structural bonds of concrete by the absorption effect and cleaving action of thin water films, and diminishes internal friction. (USBR) W69-02576

### DETERMINATION OF THE STRENGTH OF CONCRETE FOR DIVERSION TUNNEL LININGS OF THE INGURI HYDROELECTRIC PROJECT, Kh. E. Andguladze.

Hydrotech Constr, No 7, pp 645-648, July 1967. 4 p, 4 fig, 3 tab, 5 ref.

Descriptors: \*Quality control, \*Ultrasonics, Strength of materials, \*Concrete control, \*Concrete testing, \*Tunnel linings, Tunnels, Concrete mixes, Diversion tunnels, Field control, Field tests, Foreign research, Correlation techniques, Sonic waves, Compressive strength, Measuring instruments, Instrumentation.
Identifiers: USSR, \*Ultrasonic tests, Concrete pro-

The impulse ultrasonic method of investigating concrete strength was used on the diversion tunnel lining of the Inguri Hydroelectric Project. Three types of linings, all horseshoe-shaped with a raised crown, were used. The lining was partially reinforced, monolithic concrete. The impulse ultrasonic method establishes correlations between the propagation velocity of ultrasound and compressive strength of concrete of one specifice composition. Strength and uniformity of the concrete in the diversion tunnel lining were determined by an ultrasonic instrument using the method of longitudinal profiling; 3 schemes of exposure to ultrasonic waves were used, depending upon the structural member of the lining and technical possibilities. Part of the surface was exposed to slanting ultrasonic waves. This experience indicates that the impulse ultrasonic method of determining concrete strength in a tunnel lining is acceptable and fully reliable. (USBR)
W69-02580

# PROVISION OF STRENGTH AND WATER-TIGHTNESS IN THE CONTACT JOINT OF MONOLITHS OF BUILT-UP REINFORCED-CONCRETE ELEMENTS,

V. B. Safonov. Hydrotech Constr, No 7, pp 611-616, July 1967. 6 p, 4 fig, 1 tab, 9 ref.

Descriptors: \*Monoliths, Shear strength, \*Joints, Reinforced concrete, Surface properties, Concrete technology \*Forms (Concrete), \*Linings, technology, \*Forms (Concrete), \*Linings, Concrete placing, Adhesion, Precast concrete, Bondings, \*Construction joints, Foreign research. Identifiers: USSR, Form removal, Bond.

A method of providing strength and watertightness in the contact joint of monoliths of built-up reinforced concrete elements is discussed. Mechanical operations connected with surface preparation prior to making monolithic joints are eliminated. Preparation is accomplished during production by applying new types of light, removable forms-meshwork forms with burlap surfaces or metal-plastic forms. Open, removable meshwork forms are also used. To control water loss to form linings, the cells of the mesh are partially filled with a polymer during the manufacture of the metalplastic. Removing form linings from the block surface does not require lubricants. As forms are removed, the surface cement film is stripped from the block surfaces and retained on the burlap or polymer covering. After forms are removed, the surface has a canvas-like appearance and roughness. Protecting the concrete surface will guarantee good watertightness and rupture strength nearly equal to that of monolithic concrete. Shear strength of the joint will be 60-80% of the corresponding monolith strength. (USBR) W69-02581

#### 8G. Materials

#### WELDING THE HIGH STRENGTH STEELS,

R. R. Irving. Iron Age, Vol 202, No 10, pp 61-68, Sept 1968. 8 p, 4 fig, 3 tab.

Descriptors: Welded joints, \*Welding, Arc welding, Steel, Fabrication, Steel plates, Steel structures, \*High strength steel, Metallurgy, Yield strength, Metalwork, Fillers, Toughness, Heat treatment, Hardness, Heat, Electrodes, Structural

Identifiers: Electroslag welding, Narrow-gap process, Welds.

The acceptance of new high-strength steels, with minimum yield strengths of 80,000 psi and higher, is largely dependent upon weldability. Weldability is so important to the success of a new highstrength steel, that it has become a cardinal parameter as important as temperability and hardenability. High-strength steels are not difficult to weld, but are different than lower-strength steels and require special considerations. The traditional approach of matching the chemistry of the filler to the base material does not solve the problem; the problem is more complex, and matching toughness stands out as a very important criterion. Experiences of several fabricators in using conventional and new welding methods are reviewed, including the stick electrode, cold wire Tig, narrow gap, submerged arc welding, electron beam, Mig fine wire, electroslag, hot wire Tig, and plasma welding. (USBR) W69-02562

#### CORROSION OF METALS IN DESALINATION ENVIRONMENTS.

Dow Chemical Co., Freeport, Tex.; and Office of Saline Water, Washington, D. C. C. F. Schreiber, O. Osborn, and F. H. Coley. Mater Prot, Vol 7, No 10, pp 20-25, Oct 1968. 6 p, 9 fig, 1 tab, 9 ref.

Descriptors: Materials testing, Desalination plants, Demineralization, \*Corrosion, Corrosion control, \*Copper alloys, Metals, Test procedures, Metals testing, Test specimens, Environmental tests, Sea water, Oxygen content, Velocity, Temperature, High temperature research, Dissolved oxygen, pH. Identifiers: \*Corrosion tests, Corrosion resistant alloys, Corrosion environments, Corrosion resistance, Test results.

The Office of Saline Water is sponsoring a research program at Freeport, Tex, to obtain a full un-derstanding of metal behavior under desalination environments. A small-scale unit duplicates desalination plant water conditions, including variables such as oxygen content, pH, temperature, and velocity. Corrosion behavior of metals is evaluated by examining metal coupons. The corrosion test system, test procedure, and test results on copper alloys are discussed. Test results indicate: (1) dissolved oxygen concentration has the greatest single and interactive effect on copper alloy corrosion in hot sea water; (2) velocity is not a major factor in low oxygen content water; (3) increased residence time decreases corrosion rate in a closed circulation system with oxygen content in the range of 20-100 ppb, and at lower oxygen contents, increased residence time increases corrosion; (4) all copper alloys have very low corrosion rates at oxygen levels less than 5 ppb; and (5) steady-state corrosion rates are achieved within several hours of exposure under low oxygen conditions. Future studies on copper alloys and other metals will include temperature and pH variables, and ultimately, higher brine concentrations. (USBR) W69-02582

#### 8H. Rapid Excavation

### APPLICATION OF PRINCIPLES OF ROCK MECHANICS TO BLASTING AND SUPPORT OF THE NORAD EXCAVATIONS,

Barodynamics, Inc., Georgetown, Colo.; and Corps

of Engineers, Omaha, Nebr. Clifton W. Livingston, and Kenneth Lord.

Prepr No 68-AM-33, Annu Meet Amer Inst Mining, Met Petrol Eng, New York, N Y, Feb 1968. 55 p, 16 fig, 26 ref.

Descriptors: \*Rock mechanics, Blasts, Excavation, \*Supports, Geology, \*Rock excavation, Instrumentation, Underground structures, \*Rock bolts, Design criteria, Construction, Elasticity, Faults (Geology), Tunneling, Granites, Extensometers, Deformation, Bibliographies, Joints, Safety, Strain gages.
Identifiers: \*Blasting, \*Smooth wall blasting,

\*NORAD, Strain energy, Underground openings.

The NORAD Combat Operations Center, near Colorado Springs, Colo, contains large un-derground chambers excavated in pre-Cambrian granite at Cheyenne Mt. Part I of this paper reviews the construction history, identifies principles of rock mechanics applicable to blasting and rock bolting, describes some problems encountered, and explains the application of rock mechanics principles to their solution. The second part discusses rock mechanics instrumentation techniques used at NORAD. Blasting and rock bolting improvements are discussed in relation to the interdependence of blasting and support requirements. Successful excavation at a fault intersection of a 116-ft unsupported span joining 2 cylindrical openings, 73 and 63 ft in diameter, is attributed to: (1) soundwall blasting techniques capable of precisely controlling limits of excavation; (2) improvements in rock bolting capable of minimizing static elastic rebound; (3) a method and sequence of excavation designed to control release of elastic potential energy and, at final excavation limits, preserve the rock in its initial state; and (4) instrumentation capable of operating at any desired position, including close proximity to a blast, and accurately avaluating rock behavior at any instant as the work proceeded. (USBR)
W69-02563

# EXPLOSIVELY CONSTRUCTED DAM OF THE BAIPAZINSK HYDROCOMPLEX ON THE VAKHSH RIVER,

For primary bibliographic entry see Field 08D. For abstract, see . W69-02599

#### 09. MANPOWER, GRANTS AND FACILITIES

#### 9C. Research Facilities

ESTABLISHMENT OF WATER QUALITY LABORATORY AND SYSTEM FOR STORAGE AND RETRIEVAL OF INFORMATION, South Dakota State Univ., Brookings.

## Field 09-MANPOWER, GRANTS AND FACILITIES

### **Group 9C—Research Facilities**

For primary bibliographic entry see Field 07C. For abstract, see W69-02468

#### 9D. Grants, Contracts, **AND Research Act Allotments**

FOURTH ANNUAL REPORT. New Hampshire Univ., Durham.

Water Resources Research Center, Durham, N. H., August 1968. 87 p.

Descriptors: Water, Research projects, Progress reports, Accomplishments. Identifiers: Annual report.

Progress reports for ten (10) research projects are given. Significant accomplishments for five (5) completed projects are identified. Several projects report progress on the problems related to lake eutrophication. Others report on the techniques and methodology for qualitative and quantitative measurement of viruses in surface waters and the rapid identification of organic compounds in water. The Center's involvement in State and Regional affairs is identified. (Byers-New Hampshire) W69-02473

ANNUAL REPORT, 1 JULY 1967 to 30 JUNE

California Univ., Los Angeles.

A. F. Pillsbury.

Water Resources Center. Report no. 14 to OWRR, Sept, 1968. 60 p.

Descriptors: Water Resources Research, Califor-

Identifiers: California, Fresh Water Research pro-

The history, organization, and activities of the University of California, Water Resources Center are reviewed, and the publications are listed. Reports are presented on the 65 projects that the Center had underway during the 1967-68 fiscal year. These vary from projects just being initiated to projects completed during the fiscal year. These projects are all in regular teaching departments on a number of the campuses of the University; the Center itself does not conduct research, but sponsors, coordinates and disseminates information from its research projects. 19 projects were in the Water Resources Policy and Planning category; 16 were in the Water Resources Development category; 13 were in the water Resources Utilization category; and 17 were in the Water Quality Control and Waste Management category. The reports, where definite information has been obtained, are informative but written in lay language. Copies are available on request. The program of the Center is in two parts: (a) the fresh water research program, and (b) the research on the desalting of sea water and brackish water. Since annual reports of the desalting research are prepared by the 'Sea Water Conversion Research Laboratories' in the Colleges of Engineering, Berkeley and Los Angeles, this activity is not included in this report.

ANNUAL REPORT OF THE RHODE ISLAND WATER RESOURCES CENTER, FISCAL YEAR 1968, Rhode Island Univ., Kingston. Water Resources

A. Ralph Thompson.

Annual Report to OWRR for August 1968, 113 pp.

Descriptors: \*Rhode Island, \*Annual Report, Water resources projects, Water Resources Board, Symposium, Master's degree program. Identifiers: Annual Water Resources Report.

During the year ending Jund 30, 1968 the R. I. Water Resources Center was engaged in five projects involving the chemistry of water, four concerned with water quality, two with desalination of sea water, two with the properties of soils and one with aeration of water. The Center, through its coordinating committee, was responsible for drawing up an interdisciplinary master's degree program in Water Resources Engineering and Management. The Center followed closely the activities of the new state Water Resources Board in its first year of operation. On August 1, 1968 a symposium on Water Resources Research was held on the University of Rhode Island campus at which papers were presented on all projects supported by the Center under P.L. 88-379 from May, 1965 to June 30, 1967. (Author) W69-02475

ANNUAL REPORT FOR FISCAL YEAR 1968 FOR THE VIRGINIA WATER RESOURCES

RESEARCH CENTER, Virginia Polytechnic Inst., Blacksburg. Water Resources Research Center.

William R. Walker.

Annual Report to OWRR for Fiscal Year 1968, 90 pp, 4 fig.

Descriptors: Virginia, Water Resources Develop-

Identifiers: Annual Report.

The activities of the Center and its director and a listing of the members of the advisory board are included in the report. Research projects for the year include predicting watershed yield in relation to type of bedrock, removing trace organics from water by adsorption on coal, biological and chemical study of Virginia's estuaries, treating dyeing bath wastes, slowing water surface evaporation with a monolayer, and effects of zooplankton on algae photosynthesis. New courses are described in the training and education section, and new staff members are listed. A breakdown of students in water-related fields includes the number of candidates for undergraduate and graduate degrees, the number of students by field of study, and type Publications and theses for the year are also listed. (Shriver-Va Tech) W69-02476

LOUISIANA WATER RESOURCES RESEARCH INSTITUTE-ANNUAL REPORT FOR FISCAL

Louisiana State Univ., Baton Rouge.

La Water Resources Research Inst, Ann Rpt to OWRR for Fiscal Yr 1968, Aug 1968, ii pp, 54 pp.

Groundwater recharge, derground storage, Limnology, \*Chemical analysis, \*Water reuse, \*Mineralogy, \*Streambeds, Man-power, \*Economics, \*Legal aspects.
Identifiers: Lake Pontchartrain.

All ongoing research and other activities administered by the Institute, regardless of funding, are described and summarized. The work includes a multidisciplinary study of measures to counteract salt-water encroachment in aquifers underlying Baton Rouge; economics of irrigation with mu-Baton Rouge; economics of irrigation with municipal sewage plant effluent; point-bar geology of the Amite River; clay mineralogy of Lake Maurepas; and fresh-water storage in saline aquifers. Two new studies are: Limnology of Lake Pontchartrain and Manpower for the Water Industry. (Kazmann-LSU)
W69-02477

ANNUAL REPORT OF THE IOWA STATE WATER RESOURCES RESEARCH INSTITUTE FOR F. Y. 1968.

Iowa State Univ., Ames. Water Resources

Research Inst.

Iowa State Water Resources Research Institute, Reports to OWRR, August 1968. 108 pp.

Descriptors: Water Resources Research, 1968 An-

nual Report.
Identifiers: P. L. 88-379, Allotment Projects, Matching Grant Projects.

This report summarizes the activities of the Iowa State Water Resources Research Institute. Gives brief descriptions of 19 research projects funded under P.L. 88-379 through U.S.D.I. Office of Water Resources Research. Contains references for 15 publications and 4 theses. The titles of the projects are: Economic factors in the establishment of water quality stream standards; Evaluation of flood damage to corn; Moisture movement to vertical sinks in water unsaturated soil; Recession characteristics of Iowa streams; Competitive recreational uses of selected lowa lakes; Dischargevalley form relationships of selected lowa streams; Biodegradability and the chemical oxidation of carbon adsorbed materials from effluents from sewage plants; Geology of the regolith aquifers of the Nishnabotna basin; Properties of tile drainage water; Influence of geohydrology on landscape and soil formation; The energy loss of flow around alluvialchannel bends; Reoxygenation of Iowa streams; Feasibility of fish production in tertiary waste treatment ponds; Economic analysis of alternative water pollution control measures; Groundwater seepage patterns to wells for unconfined flow; Assessment of costs among drainage districts; Economic implications of the permit system of water allocation; An economic analysis of organizations of water users. W69-02478

1968 ANNUAL REPORT TO OWRR OF WATER RESOURCES RESEARCH OREGON STATE UNIVERSITY.

Oregon State Univ., Corvallis.

Water Resources Research Institute, August, 1968.

Descriptors: Hydrology, Limnology, Water law, Water institutions, Evaporation, Low flow, Economics, Water yield, Energy budget.

There were seven projects under the program 'Hydrology of Water Yield Prediction'--runoff from small streams, low flow prediction, energy and heat, water budget, soil and water movement, engineering hydrology, lysimeter. Water law, water diversion and an appraisal of water management institutions constituted a sevent management institutions constituted as sevent management institutions. stitutions constituted a second major program. A third program concerned classifying and analyzing the status of Oregon's lakes. Total research needs were weighed in coordination with appropriate federal and state agencies. Director of the Institute is vice-chairman of the State Water Resources Board. Published seminar proceedings, research results, and a periodic newsletter were given wide distribution in the state. (Buckley-Oregon State) W69-02479

WATER RESOURCES INSTITUTE, 1968 AN-NUAL REPORT.
Texas A and M Univ., College Station.

Water Resources Institute, Texas A and M University, Report to OWRR, August 1968. 180 pp.

Education, Descriptors: Precipitation (Atmospheric), Runoff, Evaporation control, Hexadecanal, Octadecanal, Ecology, Optimization, Operations research, Evapotranspiration, Hydrology, Water rights, Irrigation, Mesquitos, Recharge, Economic prediction, Limnology, Estuaries, Operations research, Transpiration control

Identifiers: Texas, Annual report, Hydrologic simulation, Groundwater pollution, Water institutions, Risk and uncertainty.

Progress in the research program in the Texas Water Resources Institute accomplished during the

period July 1, 1967 to June 30, 1968 is described. The report outlines the organization of the Institute and relates how the research program underway is directed to priority water problems in Texas. Brief reports are given on twenty-three projects. The report includes financial reporting on project costs. An educational survey is included. (Smerdon-Tex A and M)
W69-02480

## FOURTH ANNUAL REPORT OF THE WATER RESOURCES RESEARCH INSTITUTE OF THE UNIVERSITY OF WYOMING,

Wyoming Univ., Laramie. Paul A. Rechard.

Water Resources Research Institute, August, 1968.

Descriptors: \*Allotments, \*Grants, Instrumentation, Analytical techniques, \*Contracts, Streamflow regimen, Game and fish, Ecology, Planning, \*Water Resources Research Act, \*Publications. Identifiers: Annual Report.

Summary discussions of the work underway within the Water Resources Research Institute at the University of Wyoming are presented. The institute has an annual allotment program with the Office of Water Resources Research to study Criteria for Water Resource Planning, Bio-Physical Relationships in the Hydrologic Cycle, the Impact of Weather Modification and Principles of Analysis. Matching grants on varying water use and Game and Fish Resources are discussed. The report contains information on water resources education and training at the University of Wyoming and the relationships of the institute to the academic life of the campus and the public affairs of the State, and the publications of the WyoWRRI. (Author) "W69-02481"

## 1968 ANNUAL REPORT TO OWRR FROM FLORIDA WATER RESOURCES RESEARCH CENTER,

Florida Univ., Gainesville. Archibald O. Patterson.

lorida Water Resources Research Center, July 1968, 50 pp, 4 append.

Descriptors: Eutrophication, Lake morphology, Irrigation efficiency, Radioisotopes, Tracers intertidal areas, Bays, Tidal effects, Wind tides, Drought tolerance, Moisture stress, Plant physiology, Pesticide kinetics, Water use, Attitudes, Social values, Water analysis, Water law.

Seven ongoing research projects and three with 1968 starts are described. Areas covered in ongoing projects are eutrophication of Florida lakes; improving efficiency of irrigation methods in Florida to reduce water use; the use of radiometric methods in ground water studies; the behavior of water behind barrier islands when subjected to such variable stress as wind, tide, rain, and runoff; chemistry of plants when subjected to drought; preparation of a model state water-use code; mathematical model for predicting water use by population structure. New projects will deal with further studies of the use of radionuclides as tracers for hydrologic investigations; rapid water analysis methods; movement of pesticide solutions in soil. The report includes information on the raining of water scientists at the University of Florida State University and describes recent efforts to encourage support of State water agencies in the research effort in Florida universities. (Author) W69-02482

## ANNUAL REPORT OF ACTIVITIES FOR FISCAL YEAR 1968,

Illinois Univ., Urbana. Water Resources Center. Ben B. Ewing.

Annual Report No. 4, August 1968, 195 p.

Descriptors: Water resources, \*Illinois. Identifiers: Water resources research, \*Annual report.

The University of Illinois Water Resources Center was established in 1963 to 'encourage and coordinate university-wide planning and implementation of interdisciplinary programs for research and graduate education in water resources.' Since designation as the Title 1 OWRR 'institute' for Illinois, the Center's activities have become Statewide. This report describes research accomplishments and other activities of the Center during Fiscal Year 1968 and also describes plans for the remainder of the calendar year. The Center's programs are sponsored both under Title 1 of P.L. 88-379 and from other sources such as State funds. The Center's Fiscal Year 1968 research program included a total of 29 projects of which 12 were included in the annual allotment from OWRR, 10 were partially sponsored by matching-grants from OWRR and 7 were sponsored with State funds. A progress report for each project is presented. W69-02793

## 10. SCIENTIFIC AND TECHNICAL INFORMATION

ESTABLISHMENT OF WATER QUALITY LABORATORY AND SYSTEM FOR STORAGE AND RETRIEVAL OF INFORMATION, South Dakota State Univ., Brookings. For primary bibliographic entry see Field 07C. For abstract, see . W69-02468



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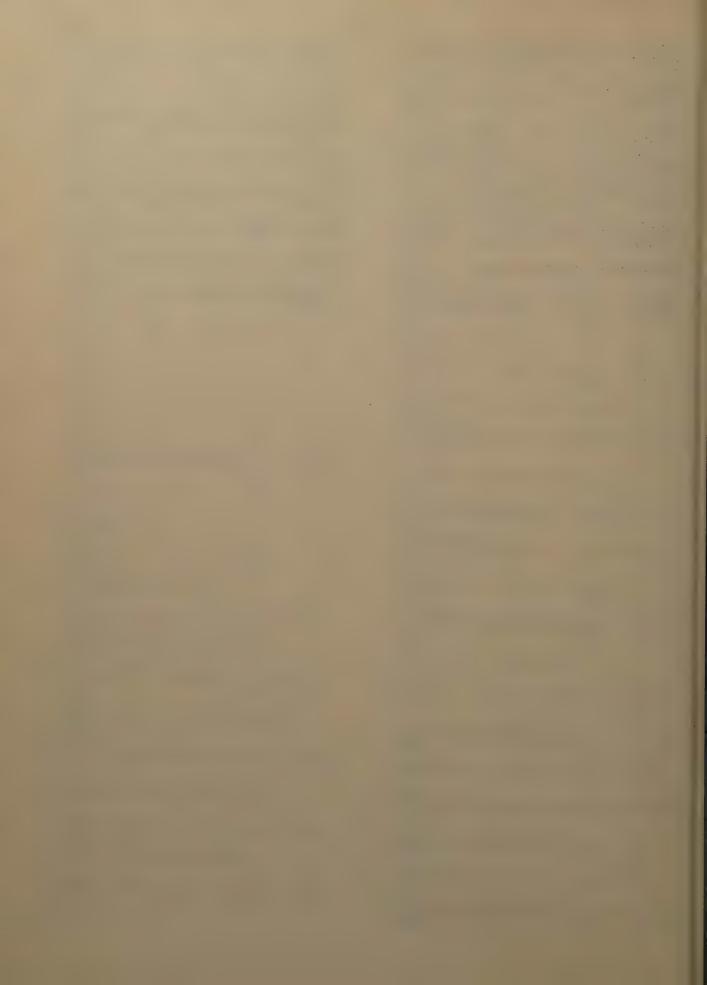
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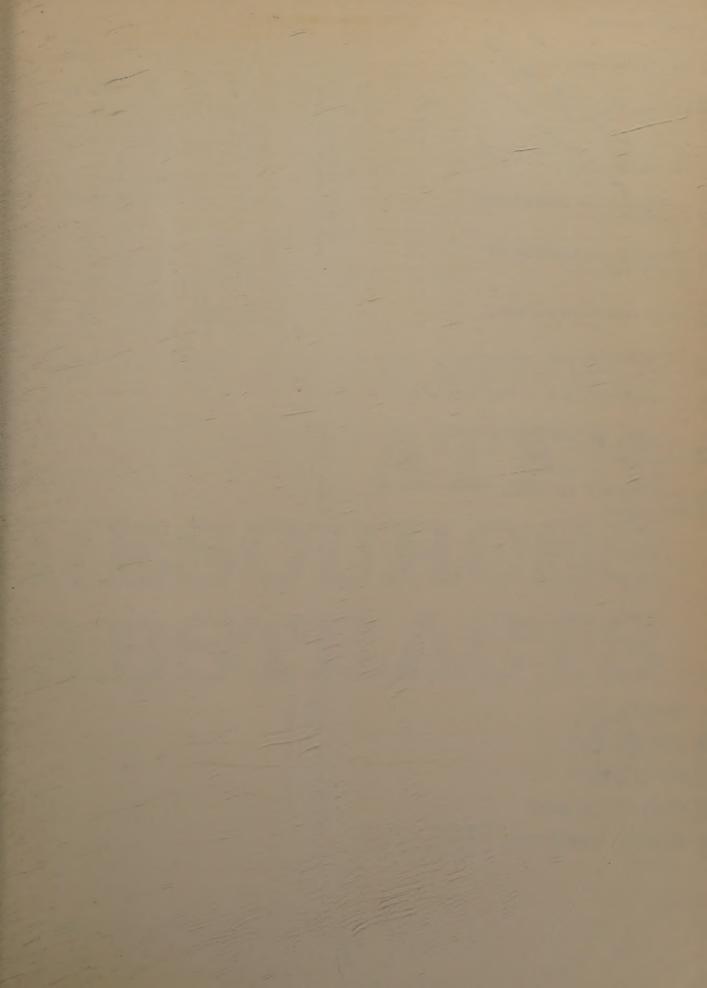


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